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An Empirical Test of Fama and French Three-Factor Model in Amman Stock Exchange

إختبار تطبيقي لنموذج Fama & French ثلاثي العوامل في بورصة عمان للأوراق المالية

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Program: Banking & Financial Sciences
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Dedication

I would like to dedicate my thesis to my beloved parents, brothers and friends.

Acknowledgment

I would like to acknowledge the help of the following people:

My mother for the time has been spent on my rest, so that, I was able to complete this work

My Father God's mercy be upon him for his guidance to me at a young age

My advisor Dr. Mohammed Al-Ajlouni for guiding me to achieved this work. Thanks for taking me on as one of your students, thanks for your continuous encouragement, inspiration and support, and thanks for your great revisions on my writings and your great advice both academically and otherwise.

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Abstract

This study aims to test empirically the ability of Fama and French (1993) Three-Factor Model in predicting monthly excess rate of return for stocks traded at Amman Stock Exchange (ASE) through period from July 2001 to April 2010. The importance of this study stems from information it provides to practitioners in ASE about risk factors that have been determined rates of return of stocks.

The study used methodology similar to one used by Fama and French (1993). Stocks in the sample have sorted according to the market value and book-to-market ratio in order to form portfolios and measuring the dependent and independent variables. To estimate the FF Three-Factor Model parameters a time series regression run by using the ordinary least square method (OLS).

The study documents positive value effect in ASE, which a portfolio of high book-to-market ratio outperformed a portfolio of low book-to-market ratio. Also, the study found small size effect, but not in a like-manner as in the U.S or other large capital markets. With respect to the FF Three-Factor Model, the study

found that this multi factor asset pricing model works better than the single factor model, i.e. the CAPM. So the study recommends the practitioners in ASE to exploit size and value effect in investment strategy and replace the FF Three-Factor Model to the CAPM in various asset pricing applications.

Keywords, Asset pricing, Multiple factors, Single factor, The Fama and French Three-Factor Model, the CAPM , Anomalies, Size effect, Value effect.

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الملخص

هدفت هذه الدراسة الى إختبار مدى قدرةالنموذج ثلاثي العوامل و الذي طورة Fama and French (1993) على التنبؤ بالعوائد الشهرية للأسهم المتداولة في سوق عمان المالي و ذلك خلال الفترة من تموز 2001 إلى نيسان 2010. وتنبع أهمية هذه الدراسة من كونها تقدم للمتعاملين في بورصة عمان للأوراق المالية معلومات عن عوامل الخطر التي تحدد عوائد الأسهم.

إستخدمت الدراسة منهجية مشابهة لتلك التي إستخدمها Fama and French (1993). حيث تم ترتيب الأسهم في العينة حسب القيمة السوقية و نسبة القيمة الدفترية الى القيمة السوقية و ذلك لبناء عدد من المحافظ وقياس العامل التابع و العوامل المستقلة. و لتقدير معلمات النموذج ثلاثي العوامل تم إجراء إنحدار السلسلة الزمنية وذلك بإستخدام طريقة المربعات الصغرى العادية.

وجدت الدراسة دلائل على وجود ما يدعى بتأثير القيمة في سوق عمان المالي، حيث أشارت النتائج الى أن المحافظ التي تمتلك النسبة المرتفعة من القيمة الدفترية الى القيمة السوقية تحقق عوائد شهرية أعلى من تلك ذات النسبة المنخفظة من القيمة الدفترية الى القيمة السوقية. وو جدت أيضا الدراسة ما يدعى بتأثير الحجم الصغير، لكن هذه الدلائل اشارت الى ان هذه التأثير في بورصة عمان يختلف قليلا عن ذلك الموثق في الأسواق المالية الكبيرة مثل الاسواق الأمريكية. اما في ما يخص إختبار قدرة النموذج الثلاثي العوامل فقد أشارت النتائج الى ان هذا النموذج يظهر قدرة افضل من نموذج تسعير الاصول المالية (the CAPM) في توقع عوائد الأسهم في بورصة عمان. و لذلك توصي الدراسة المتعاملين في سوق عمان

المالي بالإنتفاع من تأثير الحجم و تأثير القيمة في بناء إستراتيجيات الإستثمار و إستخدام نموذج Fama and French ذو الثلاث عاومل بدلا من نموذج تسعير الأصول الرأسمالية التقليدي (the CAPM) في التطبيقات المتعددة لتسعر الأصول.

CHAPTER ONE

INTRODUCTION

1-1- Preface

In 1952, Markowitz introduced his pioneering work, by which he developed a general framework in which the investor is expected to deal with investment decisions in uncertain situations. The importance of Markowitz framework comes from being considered as a cornerstone for the Modern Portfolio's Theory and other overlapping theories. **Sharpe** (1963) has simplified Markowitz model to develop what becomes known as the Single Index Model. According to the Single Index Model, the rate of returns on stock is systematically influenced by a single factor which is the rate of return on the market portfolio. After that, **Sharpe** (1964), **Lintnir** (1965) and **Mossin** (1966) simultaneously developed the first asset pricing theory that was later called the Capital Asset Pricing Theory. The theory assumes that the rate of returns on a financial asset has a linear relationship with the asset market beta. The main contribution of the theory is represented in reflecting the assumed return-beta linear relation in a famous mathematical equation which is called the Capital Asset Pricing Model (CAPM). Since its introduction, researchers have strive to

examine the CAPM validity in predicting the rate of returns on assets and other applications, such as **Black *et al.*** (1972), and **Fama and Macbeth** (1973). Most of the CAPM early tests indicated that the classical form of the theory is not consistent with real world situations. It did not take a long time before some researchers suggested modifications of the classical form of the CAPM. Some of these modifications did not get away from the basic spirit of the theory, such as **Black** (1972) who modified the classical CAPM assumption about lending and borrowing at the risk of free rate to introduce a less restricted CAPM form that was called the zero-beta CAPM. Another one went more away, **Merton** (1973), who developed a new form of asset pricing model with a continuous time horizon and multi risk factors called the Inter-temporal Capital Asset Pricing Model (the ICAPM). Although that Merton's ICAPM substantially differed from the CAPM, yet it used the same equilibrium conditions to derive a way in which the asset prices are determined in the capital market, so it is considered as a special case of the CAPM. It is true that the CAPM is the main asset pricing model which has been used in the financial community, but there were other models that appeared in the financial community, like, **Ross** (1976) who developed a well known asset pricing theory named the Arbitrage Pricing Theory (APT). The APT is an arbitraging process rather than an equilibrium condition. Moreover, it assumes that the rate of return on a financial asset is

determined by a multiple factors rather than a single factor as in the CAPM. But there was a thorny problem which obstructed the application of the APT, which was that the APT did not determine, in any way, risk factors that affect the rate of return on a financial asset, or even their number.

Since the mid-seventies and afterwards, a number of studies have found that the variations in the rate of returns between stocks are related to some characteristics such as size. Additionally, those studies have found that the CAPM has failed to explain these variations in the rate of returns between stocks. As the result of CAPM inability to predict these relations between the rate of returns on stocks and some of characteristics, the relations have become well known in the name of "anomalies". The most famous anomalies are, the size-effect (**Banz**, 1981), the rate of return that the U.S stocks is related to earnings/ price ratio (**Basu**, 1983), return-leverage relation (**Bhandari**, 1988), and a well known anomaly that is called the value-effect (**Rosenberg et al.** 1985).

In 1992, **Fama and French** studied the effect of each of the following: market capitalization, earnings/price (E/P) ratio, debt/equity ratio, and book/market ratio in an attempt to explain variations in the rates of returns between the stocks in the cross-sectional regression approach. In light of this,

they have found that the market beta alone doesn't have any explanatory power, while size, E/P, leverage and book/market ratio each alone has a power in explaining the cross-sectional variations in the average rate of returns. But when they are used jointly, the size (market capitalization) and book/market ratio have a significant power in explaining the average rate of returns and they seem to absorb the ability of leverage and E/P ratio in explaining the cross-section variations in the average rate of returns.

In 1993, **Fama and French** (FF) exploited the results of their study and published an influential paper through proposing a new alternative model to the CAPM. The FF new model contains three factors: (i) market excess rate of return, (ii) size related factor, and (iii) book-to-market equity related factor. They found that the market factor alone can not explain all variations in the rate of returns; and that the two additional factors enhanced the explanatory power of the CAPM in capturing the variations in the rate. In the light of these results, they recommended the use of their Three-Factor Model instead of the traditional model which is the CAPM.

After the appearance of the FF Three-Factor Model, many researches aimed to test its validity in different asset pricing model applications. For example, **Kothari *et al.*** (1995) showed evidence that in contradiction with

Fama and French Three-Factor Model evidence about book/market ratio effect. Moreover, **Lakonishok *et al.*** (1994) argued that high returns are associated with high book/market ratio and both are generated by an overreaction of investor to past performance. **Fama and French** (1995) found results that confirmed the Three-Factor Model. These and more recent studies have been conducted to test the validity of Three-Factor Model, such as, **Connor and Sehgal** (2001), **Drew and Veeraraghavan** (2005), and **Homsud *at al.*** (2009).

1-2- the Problem of the Study:

After its development, the Three-Factor Model has been faced by a sharp controversy and a broad discussion. A number of studies were conducted to ensure that this model is applicable and has a significant explanatory power in capturing common variations in assets rates of returns in many countries. For example, **Connor and Sehgal** (2001), who tested the model in the Indian capital market, found that the Three-Factor Model has a significant power in predicting the rates of return. **Chen and Tu** (2000) tested the model in the Taiwan stock exchange, and **Drew et al.** (2003) tested it in the Chinese stock exchange.

In Jordan, a small number of studies (e.g. **Hattab and Jamayed**, 2009) tested the ability of the CAPM to predict variations in the rate of returns of

stock and found that the CAPM is not able to explain a sufficient amount of variations in the rates of returns. Furthermore, a number of international studies tested the ability of the market beta in predicting the rate of returns in Amman Stock Exchange and did not find any relationship between the market and the rate of returns of stocks. Examples are **Calessens et al.** (1995) and **Serra** (2002).

In light of these evidences about the shortcoming of the CAPM and because of the urgent need to test the validity of the FF Three-Factor Model, this study aims to answer questions about the FF Three-Factor Model's significant power in explaining common variations in the average rates of returns of stock and its superiority to the CAPM in predicting the rates of return in Jordanian capital market. This will provide investors with satisfactory tools to analyze and predict stocks prices to make accurate decisions.

1-3- Objectives of the Study

The main objective of this study is to test the validity of the FF Three-Factor Model in Amman Stock Exchange and sought to find if this model is better than the CAPM in explaining the variations in the rate of return in Amman Stock Exchange.

1-4- Importance of the Study

This study is expected to be beneficial for the following reasons:

(i) Provides information about systematic factors that expected to have an influence on the rates of return of stocks.

(ii) Provides participants in Amman Stock Exchange with useful information, which leads to improve their decisions.

(iii) Provides investors in Amman Stock Exchange with important information about some profitable investment strategy.

(iv) The study Contributes to the literature in the field of asset pricing studies in general, and the FF Three-Factor Model in particular.

1-5- Limitations of the Study

The study exposed to some limitations, such as:

(i) The testing period Shortness, Where the study testing period extends from July 2001 to April 2010, while in studies conducted in the U.S the testing period extends between 30 and 80 years.

(ii) Small sample size used in the study. which the ASE ample doesn't exceeds a 200 socks, while the samples used in the studies conducted in some

of a large developed and emerging capital markets are reached a thousands of stocks. Small size of sample might have an effect on the results of analysis.

1-6- Methodology and Data of the Study

1-6-1- Sample of Data

The study used a sample of stocks traded at ASE and that meet a specified criteria. The Monthly data of stocks, such as, book value, market value and closing prices that released by ASE will be used to generate the dependent and independent variables.

1-6-2- Methodology

1-6-2-1- Time-Series Linear Regression Model

To test the FF Three-Factor Model the study used time series regression like one used by Fama and French (1993). This time Series regression takes the following form:

$$R_p - R_f = \grave{a}_0 + b_p [R_m - R_f] + S_p \, SMB + h_p \, HML + \varepsilon \qquad (1)$$

Where:

$R_p - R_f$: is the difference between the rate of return of portfolio and the risk-free rate (portfolio risk premium)

$R_m - R_f$: is the market risk premium.

SMB (small minus big): is the difference between the rate of return on the small market value portfolio and the rate of return on big market value portfolio.

HML (high minus low): is the difference between the rate of return on the high book-to-market portfolio and rate of return on the low book-to-market portfolio.

b_p, s_p, h_p: are the factor loadings or slopes in the time-series regression

1-6-2-2- The Procedures of constructing mimicking portfolios

To generate the dependent and independent variables needed to run a time series test of the FF Three-Factor Model, The study will build two sets of portfolios, as follow:

First set, 6 portfolios constructed in order to generate the independent variables, specifically the SMB and HML. First, stocks in the sample sorted into two groups according to their market value at June of year t, then the sample, independently, resorted into three groups according to their book-to-market ratio at December of year t-1. Finally, by intersection of the two groups, six portfolios are generated and from these six portfolios the SMB and HML will generated.

Second set, to generate the dependent variable, 16 portfolios were formed by sorting the stocks sample into four groups according to their market value and the then each one of the four market value groups resorted into another four sub groups according to their book-to-market ratio. These sorting procedures create 16 portfolios. Finally, the value-weighted rate of return computed on a monthly basis for these 16 portfolios for the period of July 2001 to April 2010.

1-7- The Study Hypotheses

The study hypothesis the following:

H1: there is relationship between the book-to market ratio and the rates of return of stock traded in Amman Stock Exchange.

H2: there is relationship between the market value and the rates of return of stock traded in Amman Stock Exchange.

H3: the Fama and French Three-Factor Model is better than the CAPM in predicting the rates of return of stocks in Amman Stock Exchange.

1-8- List of Abbreviations

(i) Anomaly: is a phenomenon in the capital markets, where stocks with certain characteristics or certain date gain abnormal rate of return and this abnormal can not be captured by the traditional asset pricing theories, specifically, the CAPM.

(ii) The size-effect: capital market anomaly indicates that the small capitalization stocks generally outperform the stocks with big capitalization.

(iii) The value-effect: capital market anomaly indicates that the low valuation ratio stocks generally outperform the stocks with high valuation ratio.

(iv) SL (Small-Low): is one of 6 portfolios formed in order to generate the dependent variables, it contains stocks that have small market value and low book-to-market ratio.

(v) SM (Small-Medium): like SL, but this portfolio contains stock with small market value and medium book-to-market ratio.

(vi) SH (Small-High): portfolio contains stocks with small market value and high book-to-market ratio.

(iv) BL (Big-Low): is one of 6 portfolios formed in order to generate the dependent variables, it contains stocks that have big market value and low book-to-market ratio.

(v) BM (Big -Medium): portfolio contains stock with big market value and medium book-to-market ratio.

(vi) BH (Big-High): portfolio contains stocks with big market value and high book-to-market ratio.

(vii) MC1.1: is one of 6 portfolios formed in order to generate the independent variable. It contains stocks in the smallest quartile (1) of market value (after sorting according to market value sample of stocks broken into quartiles with equal number of stocks in each one) and the same time in the lowest quartile of book-to-market ratio (we re broken smallest quartile market value into four book-to-market ratio).

(viii) MC1.2: is portfolio contains stocks in the smallest quartile of market value and second quartile book-to-market value of the smallest market value quartile.

(ix) MC1.3: is portfolio contains stocks in the smallest quartile of market value and third quartile book-to-market value of the smallest market value quartile.

(x) MC1.4: is portfolio contains stocks in the smallest quartile of market value and forth quartile book-to-market value of the smallest market value quartile.

(xi) MC2.1: is portfolio contains stocks fall in the second quartile of market value and in the same time have the lowest book-to-market ratio in this market value quartile.

(xii) MC2.2: is portfolio contains stocks in the second quartile of market value and second quartile book-to-market value of the second market value quartile.

(xiii) MC2.3: is portfolio contains stocks in the second quartile of market value and third quartile book-to-market value of the second market value quartile.

(xiv) MC2.4: is portfolio contains stocks in the second quartile of market value and forth quartile book-to-market value of the second market value quartile.

(xv) MC3.1: is portfolio contains stocks fall in the third quartile of market value and in the same time have the lowest book-to-market ratio in this market value quartile.

(xvi) MC3.2: is portfolio contains stocks in the third quartile of market value and second quartile book-to-market value of the third market value quartile.

(xvii) MC3.3: is portfolio contains stocks in the third quartile of market value and third quartile book-to-market value of the third market value quartile.

(xviii) MC3.4: is portfolio contains stocks in the third quartile of market value and forth quartile book-to-market value of the third market value quartile.

(xix) MC4.1: is portfolio contains stocks fall in the forth quartile of market value and in the same time have the lowest book-to-market ratio in this market value quartile.

(xx) MC4.2: is portfolio contains stocks in the forth quartile of market value and second quartile book-to-market value of the forth market value quartile.

(xiii) MC4.3: is portfolio contains stocks in the forth quartile of market value and third quartile book-to-market value of the forth market value quartile.

(xxi) MC3.4: is portfolio contains stocks in the forth quartile of market value and forth quartile book-to-market value of the forth market value quartile.

1-9- Organization of the Study

This study consists of six chapters as following:

Chapter one- Introduction

Chapter Two- Theoretical framework

Chapter Three- Literature review

Chapter Four- Data and Methodology

Chapter Five- Empirical results

Chapter Six- Summary, discussions and recommendations.

CHAPTER TWO
THEORETICAL FRAMEWORK

2-1 Introduction

Asset evaluation is a crucial process in investment decisions, whether financial or real assets. In the early beginnings, evaluation of an asset depends on the expected value of its outcomes without considering the range of possibility of these outcomes. This insufficient evaluation remained in use until **Daniel Bernoulli** (1954) introduced new concepts to finance: expected utility and risk. These two concepts represent the basis of all modern asset pricing theories and models, in which rational pricing depends on the expected return-risk tradeoff concept. The modern story of asset pricing started when **Markowitz** (1952) developed a way to build an investment frontier and put criteria within which the investors choose their investment. Markowitz's framework of investment behavior paved the way for researchers to develop theories describing the behavior of investors in pricing asset and generating rate of return of asset. According to the number of risk factors that determine asset prices, asset pricing theories are divided into two types, namely, single index model and multi index model. The best known examples of the single index model, is the widely used and well-known asset pricing theory that is called the Capital Asset Pricing Model (CAPM). On the other hand, there are various

examples of multi-index model of asset pricing, such as Arbitrage Pricing Theory (the APT) and Intertemporal Capital Asset Pricing Model (the ICAPM).

2-2- Development of the Capital Asset Pricing Model (CAPM)

In an attempt to describe how risk-averse investors invest in the securities, **Markowitz** (1952) introduced a pioneering work about securities selection and the way to build an efficient frontier, which is composed of all portfolios that achieve any of the following criteria:

1- Highest rate of return for a given level of risk (variance).

2- Lowest risk for a given level of rate of return.

Markowitz's framework described only the way investors choose their investment and did not show how these investors should allocate their funds between financial securities. Later, this model was extended by **Tobin** (1958), who explained how investors allocate their funds among different securities within the efficient portfolios. **Tobin** pointed out that an investor allocates his funds between a safe liquid asset such as treasury bills and a risky asset such as a corporate bond or stock. He also indicated that investors reflect their risk tolerance in share of funds they invest in a safe asset, which in this allocation process them separate risky asset choice from their risk preference. This allocation process has been called later as Tobin Separation Theorem. These

two important works of Markowitz and Tobin serve as the cornerstone for all subsequent developments in asset pricing theories and models.

The first of these theories is the so-called Capital Asset Pricing Model (CAPM). The CAPM was simultaneously introduced by **Treynor** (1961), **Sharpe** (1964), **Lintnir** (1965) and **Mossin** (1966). This theory is the most popular and most widely used asset pricing theory. The CAPM's main argument is that, if investors diversify their investment widely and hold efficient market portfolio, they will avoid some risk that is unique to a certain asset. Then they are concerned only about undiversifiable risk, or in other words, unavoidable risk (common market risk). According to the CAPM, this unavoidable risk should be represented by a covariation between asset returns and market returns, which is measured by the well-known statistical measure, Beta. Like any other theories, the CAPM is based on certain assumptions, most of which originally extended from Markowitz and Tobin works. These assumptions are:

1- The investor's objective is to maximize utility of the terminal wealth.

2- Investors choose their investments on the basis of their expected rate of returns and variances (as a measure of total risk) over a single-period horizon.

3- All investors completely agree on the joint distribution of rate of returns of asset.

4- All investors have the same time investment horizon.

5- The investor is a risk-averse and price taker.

6- All investors can borrow and lend money at the risk-free-rate.

7- There are no any taxes and transaction costs, or any other market frictions.

8- Investors can short-sell any amount of securities and use the proceeds to invest in any other assets.

In addition to these assumptions, there are two other assumptions, added to derive the CAPM:

9- The risk-free rate is the same for all investors.

10- All assets are infinitely divisible.

The main contribution of the CAPM stands out in that it reflects the previous assumptions and investor's behavior framework in a single simple equation. This equation summarizes the relationship between the rate of return and systematic risk (common market risk) measured by beta, as shown below:

$$E(R_{it}) = R_f + \beta_{im} [E(R_{mkt}) - (R_f)] + \square \qquad (1)$$

In this equation, E (Rit) is the expected rate of return on security i in period (t), $E(R_{mkt})$ is the expected rate of return from market portfolio in period (t), R_f is the risk-free rate of return, □ is the term error in estimating beta, which the CAPM assumes to be zero, and β_{im} is the security i market beta, which is the measure of wide market risk and equals covariance of security's returns with

market's returns divided by the variance of the rates of return on market. Mathematically this is as follow:

$\beta_{im} = cov\ (R_{it}, R_{mkt}) / \ VAR\ (R_{mkt})$.

In summary, the CAPM argues that any asset risk premium (difference between securities returns and risk-free rate, (R_{it}- R_f) is determined by the market risk premium ($R_{mkt} - R_f$) in the same period multiplied by the market beta of the asset.

Since introduced, the CAPM is the most widely and commonly used asset pricing model and is still the only model used in pricing financial asset and other applications, such as (i) measuring portfolios performance; (ii) pricing public utility products; (iii) estimating the cost of capital. As any scientific theory that will be used in life applications, the CAPM should be carefully tested. To verify this point, researchers have striven to study the CAPM and test its validity. The early empirical tests of the CAPM had been based on some hypotheses that should be true if the CAPM holds, such as: (i) there is positive relationship between the rate of return and beta and this relationship is linear; (ii) the slope of regressing rates of return on beta is equal to market risk premium, ($R_{mkt} - R_f$); (iii) the intercept of regression should be equal to the risk-free rate of return. As tests of the CAPM focus on these properties, they test the

theory indirectly by investigating if the efficient market portfolio priorities exist rather than empirically test if the CAPM single prediction of returns still holds.

One of the earliest tests of the CAPM was the work of **Douglas** (1969). He used a two-pass regression. In the first pass, the beta is estimated for assets included in the test, and in the second, the slope is estimated by cross sectionally regressing of rates of return on the ex-ante beta that is estimated in the first pass. He found that the regression intercept is higher than risk-free rate, the slope of beta is lower than market risk premium, and finally, the residual term (estimating error) is positive and statistically significant. Douglas's study suffered from some problems, as it is doubtful that these problems may cause the emergence of such results. **Miller and Scholes** (1972) took on the task to clarify some of these problems that may have caused the results to be contrary to the CAPM. They pointed out that bias in estimating beta may have occurred from: (i) the change in R_f over time, which in turn lead to increase correlation with market return (R_{mkt})' and (ii) the nonlinearity in beta-return relationship; (iii) using of an ex-ante estimated beta which may not represent true beta; (iv) nonnormal distribution of sample; and (v) problems of econometric test, certainly the heteroscedasticity. Their contribution ends here, although they highlighted the most important problems that must be avoided by studies to reach valid conclusions about relationship between beta and risk. They did not

find any direct evidence about the reliability of the CAPM in predicting rate of return. In addition to problems described by Miller and Scholes, other problems were addressed **by black *et al.*** (BJS) (1972). These problems are such as using individual securities rather than portfolios and the use of cross-sectional regression to test hypotheses under the CAPM, which may have led to a bias in estimating beta because errors term found to be not independent cross-sectionally. On a task to address these problems, BJS used methodology utilizing time-series regression and portfolios to investigate if the CAPM holds in real situation. Briefly, they constructed 10 portfolios by ranking stock in the sample according to the ex-ante estimated beta, and then allocated stock into 10 deciles. The 10 percent of stock with highest ex-ante betas go to portfolio 1, and 10 percent of stock with the second highest betas go to portfolio 2, and so on. Then, they estimated the rate of return for each portfolio through the 12 months after the formation date. Finally, they used these estimated time-series of rates of return in estimating beta and average rates of return of each portfolio and depicted the betas and average returns to get security market line (line graphically represents the CAPM risk-return relationship). Empirically, they found that the standard form of the CAPM is not consistent with the real life situation, since the intercept is more than treasury bills rate (used as a measure of risk free rate), the beta-return relationship is flatter than assumed by the

CAPM and the intercept and slope value vary through time. Therefore, BJS argued that all these evidence lead to the rejection of the standard form of the CAPM. Other rigorous study was conducted by **Fama and Macbeth** (1973), who used a methodology similar to the one used in BJS study but with some differences. After they estimated beta for individual stocks by time-series regression and ranking them to form 20 portfolios, a cross-sectional regression month by month was performed rather than the one time-series regression used by BJS. Also, they tested two other aspects of the CAPM. The first is the linearity of the relation between beta and rate of return, which is adding square of beta to the standard equation of the CAPM. In the second, they added the average of stocks residuals variances to test if there are systematic risk factors other than beta. As a result of their test, they found that the intercept value is greater than the assumed (R_f), the beta has a positive and linear relationship with the expected rate of return, and that there is no significant effect for the residual variance, and that there is no any systematic effect other than the beta. Based on these results, they concluded that investors approximately hold efficient portfolios.

The two-pass methodology introduced by the BJS and Fama and Macbeth represents the cornerstone for many methodologies used in subsequent studies that aimed to test the CAPM or its alternatives. As mentioned, the

important contribution of this methodology is that it reduced the error in estimating beta.

Accordingly, most of the early empirical tests of the CAPM argue that the standard form of the theory is not consistent with real investor's behavior in generating rates of return on assets. Also, anyone can argue that the model is based on unrealistic assumptions and the results of those tests might be caused by these unrealistic assumptions. Motivated by this argument, many researchers have acted to provide a new form of the CAPM by relaxing some of the restricted assumptions. Examples of these extensions of the CAPM standard form include the followings: short sales disallowed (**Lintnir**, 1975 and **Schnabel, 1984**), international form of the CAPM (**Solnik**, 1974), the riskless rate differentiation (**Brennan**, 1971), the form of the CAPM with non-marketable assets (**Mayers**, 1973), the CAPM form under taxation (**Elton and Gruber**, 1978), heterogeneous expectations (**Lintnir**, 1969), market with incomplete information (**Merton**, 1987), non-normal distribution (**Fama**, 1965). In addition to these, there are other extensions that will be mentioned in some detail because they are considered as the most frequently cited modifications of the standard form of the CAPM. First, **Black** (1972) relaxed the assumption of the traditional form of the CAPM about the borrowing and lending at the risk-free rate, and developed a new version of the CAPM without

risk free-rate. Instead, he argued that investor takes a short position in risky assets to form a portfolio that has a zero covariance with the market portfolio to replace of the risk-free rate asset. Accordingly, he concluded that the equilibrium equation of the rates of return may be as follows:

$$E\,(R_{it}) = E\,(R_z) + \beta_{im}\,[E\,(R_{mkt}) - E\,(R_z)] + \square \qquad (2)$$

The new factor $E\,(R_z)$ represents the expected return on the zero-beta portfolio. It is worth mentioning that the Black version of the CAPM is as known as the zero-beta CAPM.

Second, **Merton** (1973) developed a well known alternative model of the CAPM traditional model that is called the Merton Intertemporal CAPM (ICAPM). This model is a natural extension of the CAPM. The ICAPM assumed that investors make their investment decisions depending not only on the current distribution of investments returns, but also take in their considerations the future opportunities of the investment and consumption. Therefore, this model extend the CAPM in two ways: first, it assumes that investors make decisions for a continuous time-period rather than one single period as assumed by the CAPM; second, it proposes that the investor holds a multi-factor efficient portfolio, and that is more than single factor that affects assets prices. Econometrically, the ICAPM is shown below:

$$E\,(R_{it}) = R_f + \beta_{i1}\lambda_1 + \beta_{i2}\lambda_2 \,\ldots\ldots\ldots\ldots + \beta_{ik}\lambda_k + \varepsilon \qquad (3)$$

Where:

β_{i1}, β_{i2}, β_{ik}: sensitivity of an asset i rate of return to kth type of systematic risk.

λ_1, λ_2, λ_k: market price of kth type of risk.

The other side of the equation is still as in the standard form of the CAPM. Merton argued that there are two factors that seem to be important in determining rates of return of an asset, namely, a wage income and many important consumption goods. He also indicated that the results found by BJS and others about a higher value of the intercept over the risk free rate give preliminary evidence about the existence of other factors besides the market factor.

2-3- The Arbitrage Pricing Theory (APT)

Motivated by previous critiques and contradicting evidence that found by early empirical tests of the CAPM, certainly evidence about existence of multiple risk factors such as Merton's ICAPM and the Black's Z-B CAPM, researchers have strove to develop and create a new theory that could give a better and more able model in representing investor's behavior in pricing asset. **Ross** (1976) developed a new approach to explain the generating process of the

rate of return. This approach has become widely known by the name "Arbitrage Pricing Theory (APT)". Since introduced the APT has become a main, if not the only, challenger to the CAPM. The APT is based mainly on the proposition that the assets prices are generated by a certain multi-factor risk rather than a single one as proposed by the standard form of the CAPM. It also basically depends on the law of one price, which means we can not find two or more identical assets sold at different prices; in other words, any investor is not able to make arbitraging opportunities with profit. Like the CAPM and other theories, the APT depends on a set of assumptions, some of which are shared with other pricing theories, particularly the CAPM, such as:

(i) Investor is risk-averse and aims to maximize his terminal wealth.

(ii) All investors borrow and lend at the same risk-free rate.

(iii) No any market frictions, such as taxes and transaction costs.

(iv) No any restrictions on short sales and investors are free to use all proceeds in purchasing any investment.

(v) The market is efficient.

In addition, there are some assumptions that are unique to the APT, namely:

(vi) There are unlimited numbers of securities.

(vii) Investors are in agreement on the number and identities of the factors that systematically affect the assets prices.

(viii) No any riskless arbitrage opportunities with profit.

A sufficient number of securities are required to enable investors to diversify away their investments in a way to eliminate the effect of security's unique risk. Also, permitting short-selling without any restrictions and agreement of investors on the factors that jointly generate the rate of return, dictated a linear relationship between risk factors and the rate of return. Practically, if an identical asset prices differ, and investors discover the existence of such differentiation, they sell the asset with higher prices in relation to identical assets and purchase the asset with lower prices in relation to identical assets in a way to construct arbitraging portfolios with net risk and investment equal to zero. High pressure from selling and purchasing activities push the prices of lower asset to rise and of higher one to decline, and this process continues until all identical assets are in equilibrium.

As the APT implies that the rate of return on asset is determined by multi factors, and that the relationship between these factors and the rate of return is

linear. It is proposed that the following equation represents the asset returns generating process:

$$E\ (R_{it}) = R_f + \beta_{i1}\lambda_1 + \beta_{i2}\lambda_2 + \ldots\ldots.. + \beta_{ik}\lambda_k + \varepsilon \quad (4)$$

Where:

$E\ (R_{it})$: is the expected rate of return on the security i;

R_f: is the risk-free rate;

β_{i1}, $\beta_{i2,}$ β_{ik}: is the sensitivity of asset i to the kth type of systematic risk;

λ_1, λ1, λ1: is the market price associated with kth type of risk;

ε: is the error term;

As proposed by the APT and appears from above equation, any security returns should be influenced by more than one factor. Therefore, the APT is more general than CAPM, which it proposes that rate of return is generated by a single factor. Then the CAPM can be considered as a special case of the APT.

The APT has two advantages over the CAPM: (i) less restrictive assumptions, since it doesn't require knowledge of probability distributions for the rate of return, and (ii) the APT can be empirically tested in contrast to the CAPM, then can be refuted or accepted. Despite these advantages, the APT faces a considerable problem, namely, it makes no guidance about the number and type of factors that affect the rates of return on securities; it only indicates

that the common risk factors that could determine the rates of return should be uncorrelated and commonly capture the differentiations in the rate return through time and between different securities.

Anyone can argue that the above multi-factor equation shows that the APT is similar to the Merton's ICAPM, because the former also assumes that the rate of return can be generated by many factors. That is right, but the similarity ends here, as Ross argues that the APT is an arbitrage relationship more than an equilibrium condition as in the CAPM and its extensions, such as the ICAPM.

In the next phase of the APT evolution, some researchers have acted to extend **Ross** (1976) form into less restrictive situations. **Chamberlian and Rothschild** (1983), do this and argue that there is an approximate factors structure in rate of return, and this approximate factor structure exists if covariance matrix of the asset returns has only k unbounded Eigenvalues. **Ingersoll** (1984) argues that the Ross's model holds whether the residuals risk (ε) is correlated with each other or not. **Connor** (1982) and **Chen & Ingersoll** (1983), argue that when a finite number of assets exist, the Ross's model still holds if the competitive equilibrium conditions exist and the market portfolio is well diversified in a given factor structure, also the linear pricing relation exist

if investors are able to construct a well diversified portfolio in a given factor structure and with no any nonsystematic risk. All of these extensions are meeting at one point: they suggest that the APT pricing relation can be held without the existence of some restrictive assumptions.

After theoretical formulation and extensions development, the APT now needs to be examined and investigated empirically in a way to determine if the theory holds in the real world or at least shows an adequate level of ability to describe behavior of investors in the pricing of securities. As a result of the main problem that challenges the ability to apply the APT, which does not specify in any form the important factors in the pricing of assets, early empirical investigations of the theory were intended to detect if there are multiple important factors in pricing assets and to determine the number of these factors that systematically affect assets prices. To verify this aspect, a statistical technique was used by researchers. This technique is called the factor analysis, which is useful in specifying the factors that capture the common variation in rate of return among securities. In addition to this technique, early tests of the APT used a two-stage methodology similar to that developed by the **BJS** (1972) and **Fama and Macbeth** (1973). The first one of these studies was conducted by **Roll and Ross** (1980) **(RR)**, who analyzed data of 42 groups with

30 stocks in each group selected alphabetically through a time period from July 1962 to December 1972. Their results indicate that there is more than one important factor in pricing asset; specifically, there are four to three significant factors in pricing asset and generating asset returns. In addition to **RR**, other researchers reached the same results about existence of a multi-factor structure in asset returns generating process, such as, **Chen** (1983), and **Cho** ***et al.*** (1984), which reestimate the RR analysis for later period and found more significant factors than those found by RR's study. At another side, other researchers criticized these studies and their results. Some of them (**Dhryms** ***et al.*** (1984), **Dhryms** (1983)) argued that the factor analysis used by these studies have produced variant results as we alter period and number of stocks in each group or the groups themselves, those. Before that, **Shanken** (1982) criticized the APT in that the factor analysis can be manipulated by altering the groups used in tests, which leads to producing an infinite different factor structures. Accordingly, Shanken argued that this problem may make it impossible for any one to check the validity of the APT.

In addition to these problems, researchers pointed to other important problem that has been associated with using the factor analysis in estimating factor structure and testing the validity of the APT. The problem is that the factor analysis techniques do not specify what these factors are, or in other

words, the factor analysis is limited to determining the number of factors that investors take into account in pricing asset without determining what these factors are. So we can not give an economic interpretation of the relationship between those factors and assets returns. **Roll and Ross** (1980) suggest that, "an effort should be directed at identifying a more meaningful set of sufficient statistics for the underlying factors". Motivated by this problem, researchers used alternative methodology. This methodology uses fundamental variables that are theoretically assumed to be pervasive factors in affecting asset prices. A famous example of these studies is **Chen *et al.*** (1986) who used macroeconomic variables as risk factors. Their test is motivated by the APT main idea that there is a small number of factors that might commonly affect asset prices, and according to the modern financial economics theory, asset prices are influenced commonly by the flow of new information about economic fundamentals. Accordingly, they argued that assets prices change according to the change in two variables, namely: (i) expected cash flow and (ii) discount rate. In turn, these two variables are influenced by the following macroeconomic variables: (i) inflation, (ii) industrial production, (iii) term structure, and (iv) default risk. Then, on the basis of these relations, they test the hypothesized relations between these pervasive macroeconomic variables and stock rates of return by running the following cross-sectional regression:

$$R_{it} = R_f + \beta_{mp}MP + \beta_{dei}DEI + \beta_{ui}UI + \beta_{upr}UPR + \beta_{uts}UTS + \varepsilon \quad (5)$$

Where;

R_{it}: is the monthly rate of return of portfolio i.

MP: is the monthly growth rate in industrial production.

DEI: is the change in expected inflation.

UI: is the anticipated inflation.

UPR: is the anticipated change in the default risk premium.

UTS: is the anticipated change in the term structure.

Using the above cross-sectional regression and applying a methodology similar to the one introduced by **Fama and Macbeth** (1973), Chen it al. found that, except for the change in expected inflation, all variables have a significant explanatory power in determining stock returns. In addition, they found that when the market beta is added, it did not improve the explanatory power of the model. In turn, **Fama and French** (1989) investigated the ability of some business condition proxy variables to predict the rate of return, such as, term structure, default risk premium, and dividend yields. They argued that these three variables may serve as proxies for rate of return volatility that result from business cycles fluctuation; therefore, according to rational pricing, investors should take it in their consideration. To test these hypothesized relations, they

constructed portfolios from bonds and stocks, by using data for the period from 1927 to 1987 they run the following time-series regressions:

$$R(t, t_{+1}) = \grave{a} + bD_{(t)}/P_{(t)} + cTERM_{(t)} + \varepsilon_{(t, t+1)} \quad (6)$$

$$R(t, t_{+1}) = \grave{a} + bDEF_{(t)} + cTERM_{(t} + \varepsilon_{(t, t+1)} \quad (7)$$

Where:

$R(t, t_{+1})$: is the expected rate of return on the stock and bonds portfolios.

$D_{(t)}/P_{(t)}$: is the dividends yield.

DEF: is the default risk premium.

TERM: term structure.

It is worth mentioning, that the study separated between the dividends yield and default risk effects, because the two variables are supposed to capture a long term variation in rate of return, so it is assumed to be highly correlated. They found that the dividends yield and the default risk variables strongly measure long-term business conditions and the same thing for the term structure but for short-term conditions. Finally and most importantly, they found that all these business conditions proxies significantly capture a common variation in the rate of return either for a stock or for a bond.

Other studies aimed to investigate the impact of macroeconomic variables on the rate of return and argued that the generating process of rate of

return has been affected by multiple factors other than single market beta of the CAPM. Examples of these studies are **Burmeister & McElroy** (1988), **Schwert** (1990), **Ferson & Harvey** (1991), **Clare & Thomas** (1994), **Elton *et al.*** (1995), and **Cheung *et al.*** (1997).

CHAPTER THREE

LITERATURE REVIEW

3-1- Emergence of the Fama and French Three-Factor Model

The macroeconomic variable approach has been used by many researchers to investigate if asset pricing process is influenced by many common factors, and if the macroeconomic variables represent these common risk factors. Similar to this approach, efforts have been made by other researchers to investigate the impact of multiple variables other than market beta on securities returns, but they differ in terms of what variables are used in the analysis, since they used microeconomic variables other than macro ones. In other words, they used characteristics of securities as common variables in predicting securities returns and to infer if securities pricing process is a multi-factor one, then to suggest what types of factors that misspecified by the well established asset pricing models, especially the CAPM.

Through using this approach, many researchers have found that there are additional factors besides to the market beta. The most important evidence about effect of such variables was documented by studies such as **Basu** (1977) who found that stocks with high earning to price ratio (E/P) gain a higher risk-

adjusted rate of return (adjusted in the sense of the CAPM) than stocks with low E/P ratio. **Rozeff and Kinney** (1976) documented the widely known stock markets phenomena that are called January Effect, in that the U.S.A stock market earns substantially higher rates of return in January than any other month. The same evidence was also found by **Keim** (1983). **Banz** (1981) introduced one of the most important contradictory evidence against the CAPM, when he found that stocks with lower market capitalization generated higher rates of return than ones with higher market capitalization, and when he added market capitalization to the CAPM, it improved the explanatory power of the model. This evidence is what has become to be known as the Size Effect. In turn, **De Bondt and Thaler** (1985) found a reversal pattern (from 3 to 5 years) in the long-term rate of return. They argued that stocks with past poor performance tend to earn higher rates of return than stocks that well performed as will as the market. Opposite to this long term reversal pattern, **Jegadeesh and Titman** (1993) found a continuous short-term pattern (from 6 to 12 months) in the rate of return, in which higher rate of return is still earned by past winner stocks over loser ones. Finally, **Rosenberg *et al.*** (1985) documented another of the most important influencing factors in asset pricing, namely, book value to market equity value ratio (Bv/Mv). they argued that stocks with high Bv/Mv have higher rate of return than stocks with low Bv/Mv.

Such evidence have raised doubts about the ability of the CAPM to predict asset returns. Also these evidence and many others are regarded as the basis for most trading strategies that have been widely used in financial markets.

Not only the CAPM, but also the APT (the factor analysis method) has tested in terms of their ability to capture some evidence of the CAPM shortcomings. An example of these investigations, the study of **Reinganum** (1981), which empirically investigated the ability of the APT to capture differences in the rate of return between small market capitalization stocks and large market capitalization stocks (size-effect). He used a two-stage methodology. First, factor loading for each stock in the sample was estimated, then all stocks with a similar factor loading are grouped together to construct a control portfolios in a way to compute excess returns for all stocks in the sample by subtracting stocks returns from a control portfolio returns with a similar factor loadings. Secondly, stocks are ranked according to their equity market value in a way to construct 10 portfolios, and average excess rate of return for each portfolio is computed. He argued that as the excess rate of return computed in a way to account for control of the APT risk, and then if the APT holds, all excess rate of return should be indistinguishable from zero, but the evidence resulting from the test showed what is contrary to the APT, since small market capitalization portfolio earns 20% of the yearly excess rate of

return over large market capitalization portfolio. Therefore, the APT fails to capture the size-effect. In addition to this evidence, **Cho & Taylor** (1987) found that the January Effect still exist even after controlling for the APT risk. The same result was also found by **Gultekin & Gultekin** (1987).

As the CAPM and APT have failed to capture some differences in the rate of return from securities that appear to be occur from differences in characteristics of firms, academics and practitioners considered these evidence and variables as anomalies and puzzles. This means that the CAPM may be misspecified and there are omitted factors. Accordingly, use of the CAPM and other alternative models in pricing asset and decision making in investment process is inconvenient and wrong. Thus, the situation requires development of a new model to replace the existing questionable models. This new model should at least be able to capture the existing shocking anomalies and be significant economically and statistically in predicting securities prices. In order to achieve this and develop a model to replace the existing models, **Fama and French** (1992, 1993)(**FF**) have developed a new model. In the first study (1992), they concluded that size (measured by market value) and Book-to-Market equity (Bv/Me) variables strongly capture the cross-sectional variations in the excess rates of return associated with size, Bv/Me, E/P ratio, and leverage

variables. In their second study (1993), they exploited this conclusion to build a new multi-factor model, which has become known as the FF Three-Factor Model because it assumes that securities returns are affected by three factors only, namely:

(i) Market risk premium rate of return, which is measured by the difference between the market return and the risk-free rate.

(ii) Equity market value, which is measured by the number of shares outstanding multiplied by the market price per share.

(iii) Book-to-market equity, which is measured by the book value of equity divided by the market value of equity.

They used a methodology like the one used by **Black *it al.*** (1972). In the first stage, they sorted stocks according to their market value and book-to-market ratio, and then divided each sort to five equal parts (5 quintiles) to form five equal portfolios according to market value and another five portfolios according to book-to-market ratio. For example, twenty percent of the stocks in the bottom of market value ranking have used to construct the smallest size portfolio, and so on, and the same thing was done for the book-to-market ranking. After that, they constructed a twenty-five portfolio by the intersection of five market value portfolios with the book-to-market five portfolios, and then its rates of return were calculated to be used as dependent variable in the test.

They also constructed the factors that were supposed to be proxies for risk factors that affected rate of return. in the second stage, a time-series regression was conducted to test the relationship between the mentioned three factors and the rate of return on 25 portfolios. Finally, they concluded that common variation in stock returns can be predicted by the following formula:

$$R_p - R_f = a_p + b_p [E (R_{mkt}) - R_f] + S_p SMB + h_p HML + \varepsilon \quad (8)$$

Where:

$R_p - R_f$: is the difference between the rate of return of portfolio and the risk-free rate (portfolio risk premium)

$E (R_{mkt}) - R_f$: is the market risk premium.

SMB: is the difference between the rate of return on the small market value portfolio and the rate of return on big market value portfolio.

HML: is the difference between the rate of return on the high book-to-market portfolio and rate of return on the low book-to-market portfolio.

b_p, s_p, h_p: are the factor loadings or slopes in the time-series regression.

FF have argued that the above model is statistically and practically better than the CAPM in predicting the price of a stock and can be used in an other applications of pricing model, such as evaluating portfolios performance, selecting securities, measuring abnormal rate of return in event studies, and

estimating the cost of capital. They pointed out to a strong evidence of robustness of their proposed Three-Factor Model, its ability to predict rates of return of portfolios that are constructed according to some anomalies, such as earning price ratio and dividend yield, in addition to its ability to capture the January Effect.

Since it was developed, the FF Three-Factor Model has represented a compelling argument against the CAPM, and an altering point has occurred in the financial markets community, which argument of the FF about the new model is consistent with the multi factor asset pricing theory and models such as the Ross's APT and the Merton's ICAPM. This means that this model should be used in many important investment decisions. However, this model, like any other model, should be exposed to many tests. Therefore, many researchers have directed their efforts to examine this model from different perspectives. Some of them investigated a theoretical explanation for a multi prediction process that was proposed by the FF Three-Factor Model, especially the predictive power associated with SMB and HML factors of risk. Also, there are others who have examined if the Three-Factor Model holds with periods and samples other than ones used by FF. All these efforts have produced a large amount of evidence around the Three-Factor Model, some of which accept the

model predictions as risk factor-based and others have refuted this story or the hold of the model at all.

3-2- An Interpretation for a Multi-Prediction of the FF Three-Factor Model

Since the development of the FF Three-Factor Model and before that when the anomalies upon which rested the model were documented, researcher's concerns were directed towards the problem of explanation that was associated with these anomalies and the FF Three-Factor model, which found no certain explanation for the relation between the size (SMB) and book-to-market equity (HML) and securities returns. The attention of researchers in this problem produced a large number of evidence about possible explanations for the SMB and HML prediction power. But all these explanations fell into three groups: (i) SMB and HML explanatory power is a statistical artifact; (ii) rationality of investor's behavior; (iii) irrationality of investor's behavior.

3-2-1- The Explanatory Power of the SMB and the HML is a Statistical Artifact

In attempt to determine an explanation for the explanatory power of the additional factors, the size related factor (SMB) and the book-to market equity

related factor (HML) that proposed by the FF Three-Factor Model, some researchers have argued that the statistical measures and tests may account for a relation between securities returns and these factors. One of the first studies is **Roll** (1981) which suggested that the small capitalization firms are characterized by more infrequent trading than big ones, and then auto-correlation in their rates of return will be higher, which in turn caused downward-bias in measuring risk either by beta or variance. Therefore, it appears that the small capitalization firms earn higher rates of return than big capitalization firms with an equal risk. In turn **Reinganum** (1982) examined Roll's possible explanation of the Size-Effect. He used a measure of beta like the one used by **Demson** (1979), which gives more appropriate measure of the systematic risk when a stock has been exposed to an infrequent trading. He argued that the downward-bias really occurs but is too small to fully explain the premium in the rates of returns of small stocks over large stocks. **Christie and Hertzel** (1981) suggested the same downward-bias but with different reason. This reason is the using of historical beta, in which small stocks tend to have higher current leverage than historical ones because its market value is usually less than in the past, and then their current beta tends to be higher than the historical one. Further reason for the bias was provided by **Blume & Stambaugh** (1983), which indicated that the magnitude Size-Effect is

significantly influenced by the method of computation of the rate of return, such as use of the arithmetic mean which caused upward-bias in measuring returns. Another bias was discussed by **Lo and MacKinaly** (1990) who argued that the grouping of stocks to form a portfolio in a way used by studies that attempt to tests the asset pricing models may lead to distorting the results of tests, because sorting the stocks according to some characteristics such as size and other anomalies may serve to increase the correlation between estimated errors inherent in the model intercept, which in turn may lead to exaggerate the relations between the rate of return of portfolios and those characteristics. To address this bias, **Chan *et al.*** (1991) used individual stocks rather than portfolios, and found that the results did not differ substantially from those that used portfolios.

Kothari *et al.* (1995) documented the survivorship-bias in FF Three-Factor model, particularly book-to-market equity (HML) factor. They argued that FF used a sample of stocks from COMPUSTAT database which are not available data about distress unsurvivor firms, most of these firms are with high book-to-market equity. Accordingly, the rates of returns of portfolios of the high book-to-market equity stocks will be inflated and biased up, leading to the emergence of positive relationship between the HML factor and rate of return occurs. They found that the relationship is weaker than found by FF if data from

CRSP database are used. But this evidence about a survivorship-bias was weakened by a large amount of evidence found in studies using samples other than COMPUSTAT, such as **Chan *et al.*** (1991), **Connor & Sehgal** (2001), and **Pham** (2007).

3-2-2- Rationality of Investors

Despite that FF argued that the Three-Factor Model is consistent with the multi factor asset pricing theories such as the APT and the Merton's ICAPM, there is no satisfactory explanation for multi predictions of the model. However a large number of economical explanations for the predictive power of the market capitalization and book-to-market equity have been found by several studies.

In attempt to provide explanations for their results FF pointed out that there are many stories about the size and book-to-market equity predictive power, but they suggested that a possible explanation may be that the size and Book-to-market equity are proxies for common business conditions and pervasive economic risk factors. This means that the differences in rates of returns between small market capitalization portfolios and big ones may work in the same way that the market risk premiums (R_{mkt}-R_f) function in predicting rates of returns of other portfolios and stocks. The same thing is also true for the

HML factor. In other words, we have the size risk premium (SMB) and value risk premium (HML) besides the market risk premium. As evidence of these explanations, **Chan *et al.*** (1985) examined the relation between the market capitalization variable and **Chen *et al.*** (1986) economic risk factors. They found that the relationship between market capitalization and the rate of return is a proxy for the more general relationship between the rate of return and pervasive macroeconomic risk factors, specifically, the default risk. Also, **Chan and Chen** (1991) found that a large proportion of small market capitalization firms have low production efficiency and high financial leverage; consequently, small firms are more exposed to risk than big ones. This justifies the premium for small firms. By expanding previous work of Chan and his colleagues, **He and K.ng** (1994) found that, in addition to the explanation of size as a proxy to macroeconomic risk, the book-to-market equity variable predictive power can be explained by relative distress factor (dividends-cutting-criterion), and then the book-to-market equity variable may serve as a proxy for distress risk. An additional evidence of risk-based explanation of the high book-to-market equity risk premium is **Fama and French** (1995), who argued that high book-to-market equity gives a signal of future earning opportunities, which shows that low book-to-market equity portfolio is a signal of strong earnings and vice versa.

All previous evidence supports the risk-structure explanation for the SMB and HML factors, but in addition to this evidence, there are other economic interpretations for the market capitalization and the book-to-market equity, particularly the market capitalization effect. One of these explanations is called the Neglect-Effect that was documented by **Arbl & Strebl** (1982), who indicated that firms neglected by the market players suffer from a lack of information about their fundamentals, which in turn leads to increased uncertainty and thus increases the risk and cost of investment in these neglected firms. In turn, **Barry and Brown** (1985) and **Bhardway and Brooks** (1992) found that small Size-Effect is a proxy for the Neglect Effect as the small firms are always neglected by analysts and investors, so a premium to invest in them is required. Other researchers explain small Size-Effect as a result of different investment costs between small and large firms. One of them is **Stoll and Whaley** (1983), who argued that the transaction costs are inversely related to the stock price and liquidity of the stock and this may account for differences in rates of returns between small and large firms. As empirical evidence, they found that transaction costs partially account for the premium rate of return with small capitalization stocks. Moreover, **AL-Rjoub & Hassan** (2004) concluded that the transaction costs fully accounted for the differences in rate of return.

3-2-3- Irrationality in pricing behavior

In contrast to asset pricing theories and others capital market theories that assume rationality in investor's behavior in assets pricing and the impossibility of obtaining an abnormal rate of return without incurring an appropriate amount of risk. There is opposite evidence about irrationality in pricing and the ability to earn an abnormal rate of return from investor's pricing errors by constructing portfolios that exploit this mispricing.

One such evidence was found by **De Bondt & Thaler** (1985), who argued that investors overreact to unexpected events; therefore, the portfolios of losers stocks in the past, on average, earn higher rates of return than portfolio of winners stocks, specifically in the month of January, even though a winner portfolio is exposed to a higher risk. In line with this evidence, **Fama and French** (1992) pointed out that the market capitalization and book-to-market equity effects can be explained by the overreaction in investor's pricing behavior. Additional evidence about irrationality was found by **Lakonishok *et al.*** (1994), who concluded that value strategies (such as investing in high B/M equity stocks) outperformed glamour strategies (such as investing in low B/M equity stocks). Consequently, they pointed out that these excess rates of returns for high book-to-market equity is the case of under-pricing by investors rather

than by more risk. Another explanation of the Size-Effect in terms of irrational pricing behavior is the January Effect. **Keim** (1983) found that in the U.S and Japan the January-Effect accounted for most of market capitalization effect, where small firms have earned significantly higher rates of return in January, particularly in the first week of this month, since 50% of the Size-Effect is due to the January-Effect. **Roll** (1983) and **Rathinasamy and Mantripragada** (1996) provided an explanation for the small Size-January effect. They pointed out that the investors at the end of year are selling stocks that suffer from negative rates of returns through the year in order to realize capital losses to offset capital gains from other investments in a way to decrease their personal tax liability. Roll conjectured that a large proportion of small capitalization firms are owned by non-tax-exempt-investors, so the effect will be more on them. Regardless of the time in which it occurs and the reasons behind it, all previous evidence agrees that investors overreact to some events and that the most beneficiary from this irrationality are portfolios of small market capitalization and high book-to-market equity.

3-3- A Various Evidence about Robustness of the FF Three-Factor Model

In responses to FF's argument about the ability of their FF Three-Factor Model to predict the rate of return of stocks and its superiority over the widely used classical model (the CAPM) and as a result of recommendations for its use in various roles of asset pricing model, such as, portfolios performance evaluation, determining cost of capital and important investment decisions, many studies aimed to explore if the model is holding, is able to predict a stock's returns and is useful in different asset pricing applications. These investigative studies vary in terms of methodology and samples, where the FF Three-Factor Model was exposed to investigation in many countries, with different periods and statistical tests techniques. A large number of these studies have used a two-stage methodology similar to that used in FF to develop the FF Three-Factor Model. An example of them is **Fama and French** (1996), who tested the ability of FF Three-Factor Model to capture differences in the rate of return that appear in accordance to some anomalies, such as, long-term reversal pattern in rates of returns on stocks, short-term continuation pattern in rates of returns, earnings/price ratio, cash flow/ price ratio and sales growth, that still shocked the CAPM. By using data from the U.S markets through the period of 1963 to 1993, they found that, except for the short-term momentum, the FF

Three-Factor Model performed well in explaining all the previous investigated anomalies. In response, they argued that the FF Three-Factor Model is just a model and it is natural to be unable to explain all variations in rates of returns of stocks. Another study was conducted by **Connor and Sehgal** (2001), who tested the model by using the Indian market data from 1989 to 1999 and found that the FF Three-Factor Model holds in the Indian market. **Drew and Veeraraghavan** (2003) examined if the FF Three-Factor Model has more ability over the CAPM in Hong Kong, Korea, Malaysia, and the Philippines through the period of 1991 to 1999. They found that the FF Three-Factor Model has a more explanatory power over the CAPM in all these countries. The same result was found by studies, such as **Gaunt** (2004) for Australian market, **Drew *et al.*** (2005) for Chinese market, **Lajili** (2007) for French market, **Rogers and Securato** (2009) for Brazilian market, and **Homsud *et al.*** (2009) for Thailand market.

In addition to the previous studies, other studies used the **Fama and Macbeth** (1973) cross-sectional methodology, besides the time-series regression. However, they found that the FF Three-Factor Model is better than the CAPM. For example, **Lawrernce *et al.*** (2007) found a better explanatory power for the FF Three-Factor Model over the Three-Moment CAPM and the

traditional CAPM, and **GÖKGÖZ** (2007) found the same preference for the FF Three-Factor Model in the Turkish market.

Some researchers argued that it is difficult to apply the FF Three-Factor Model with the previous two-stage methodology. Therefore, they addressed this problem by using already existing indexes to construct the SML and HML factors and established market industries in place of the portfolios that were constructed based to size, or other anomalies. An example is **Faff** (2001) who tested the model by using the Australian data for the period of 1991 to 1999. He found that the model is priced by investors. Similarly, **Pham** (2007) conducted the same simple methodology on Japanese market through the period of 1984 to 2004, and found the same result.

In addition, some researchers tested the ability of the FF Three-Factor Model in various applications of asset pricing models. **Hu** (2003) compared the use of the FF Three-Factor Model and the CAPM in capital budgeting and found that the FF Three-Factor Model, in the short-term, has performed better than the CAPM. **Naceur & Ghazouani** (2007) argued that the FF Three-Factor Model is more useful than the CAPM in estimating cost of capital within the Tunisian banking sector. In addition, **Chahine** (2008) and **Clement *et al.***

(2009) used the FF Three-Factor Model in evaluating investment strategies in the Euro Zone markets.

CHAPTER FOUR

DATA AND METHODLOGY

4-1- Introduction

This chapter describes in some detail the sample of data and the empirical test procedures that are used to examine the ability of the FF Three-Factor Model in explaining excess rate of return for securities traded in the Amman Stock Exchange (ASE). It consists of four sections. In section one, the data and sample are discussed. Section two describes the procedure of aggregation stocks to form portfolios for the purpose of constructing the model's input variables. Section three describes how to measure and estimate input variables used in the composition of the model. Finally, section four describes the statistical tools that are used to test the ability of the model to explain excess rats of returns.

4-2- The Data

This section describes raw data and their sources. Criteria to choose the sample of stocks are shown; a way to measure raw material data is described and sources of these data are determined in this section.

4-2-1- The Sample of the Study:

This subsection describes the raw data and their sources from which the model's input variables are generated.

The sample of the data that used in this study to perform empirical test of FF Three-Factor Model contains stocks that are traded in ASE and which achieved the set of chosen criteria. The set of criteria were selected on the basis of access to the sample of data suitable for analysis. These criteria are:

(i) A stock should be traded at June of year t and at June of year t-1. Also, it should have disclosed book value of equity for December of year t-1.

(ii) Each stock with negative book value was excluded from the sample.

(iii) Each stock without a trading record for more than two consecutive months was excluded from the sample.

(v) Each stock with turnover ratio less than 0.2% monthly was also excluded from the sample.

The first criterion is a traditional one and was used by Fama and French (1992, 1993) and subsequent studies that aimed to test the FF Three-Factor Model. We are matching market value in June of year t with book value of a stock at December of year t-1 for each stock to be sure that book value data are available to the public and to avoid a possible look-ahead bias, which investors consider this data in generating asset return for period t to t+1. The second

criterion is consistent with previous studies, where stocks with a negative book value are excluded to prevent the result from distortion and because interpretation of results will differ for stocks with negative value. Generally, there is no severe impact on the number of firms in the sample where firms with negative book value were excluded. Only two firms were excluded according to this criterion. This study imposes the third and fourth criteria to reduce the impact of a stock with thin trading. Turnover ratio limit is chosen arbitrarily in a way to reduce the negative impact of thinly traded stock and to maintain an appropriate size of the sample. Application of these four criteria for the period from December 2000 to June 2009 gives a list of stocks qualified for the purpose of constructing mimicking portfolios.

The rate of return for each stock in the sample contains capital gain and dividends yield calculated on a monthly basis. Market capitalization either at December of year t-1 or June of year t was measured by a number of shares outstanding multiplied by the market share price in the corresponding month. For book value, the study used book value that was found in monthly statistical bulletin released by ASE. It is worth mentioning that to measure the market capitalization and rate of return for each stock, the study used monthly closing price as a proxy for selling and buying prices. As a proxy for market rate of return, the current study used monthly changes in the value-weighted index of

ASE. This index used 1991 as a basic year and represents 90% of ASE market capitalization. The study used this index in line with previous literature, and because this index more appropriately reflects investment behavior in stock market. At the end of each month throughout the testing period, from July 2001 to April 2010, change in closing value for forth motioned index was used as a proxy for the rate of return on the market portfolio. Rate of return on the Three-month treasury bills was used as a proxy for the risk free rate. Table (4-1) shows the average of sample characteristics.

Table (4-1)

Average of Sample Characteristics

Year	# of Firms	MCAP	B/M Ratio	V.Index
2001-2002	76	33	1.60	1672
2002-2003	93	44	1.53	1772
2003-2004	96	50	1.65	2574
2004-2005	105	73	0.86	4753
2005-2006	131	168	0.68	7724
2006-2007	125	157	0.68	5991
2007-2008	175	122	0.68	7590
2008-2009	168	226	0.67	6937
2009-2010	161	117	0.99	5555
Average	**126**	**110**	**1.04**	**4952**

Source: calculated by the researcher
Note: MCAP, is the market value of sample in million of Jordanian dinar
B/M Ratio: the book-to-market ratio measured at Dec t-1
V.Index: the value weighted index of ASE

4-3- Portfolios Aggregation Procedures

This section describes the steps of constructing mimicking portfolios used in measuring FF Three-Factor Model input variables (dependent & independent variables). This procedure is similar to the one introduced by **Fama and French** (1993) to formulate and test their FF Three-Factor Model. The study differentiates between two sets of procedures: the **First** set of procedures is an aggregation of stocks in a way to construct portfolios mimicking factors that are used as dependent variables in time-series regression. Specifically, the market capitalization mimicking factor, symbolized SMB, is measured as the difference in the rate of return between small market capitalization portfolio and big market capitalization portfolio, and a book-to-market mimicking factor, symbolized by HML, and measured as the difference in the rate of return between high book-to-market portfolios and low book-to-market portfolios. The **Second** set of procedures is directed to aggregate stocks to construct portfolios and calculate portfolio's rate of returns, which act as a proxy for a dependent variable in time-series regression.

This study follows in the footsteps of **Fama and French** (1993) and other studies conducted to test FF Three-Factor Model. The First step in portfolios formation is to construct mimicking factors, namely SMB and HML, is to sort stocks in a sample according to their market value. At June of year t,

all stocks in the sample are sorted according to their market value at end of this month. Then these sorted stocks are classified into two groups according to the median of the market value of the sample. Lower than the median group of stocks forms a small capitalization portfolio, which is denoted by (S), and higher than median group of stocks forms big capitalization portfolio, which is denoted by (B). Then, stocks are resorted (independently) according to their book-to-market value ratio. Recall that this ratio is measured at December of year t-1. Again as in market value sorting, this sorting is classified but into three groups rather than two, based on the breakpoints for the bottom 30% (Low book-to-market portfolio (L)), middle 40% (Medium book-to-market portfolio (M)), and top 30% (High book-to-market portfolio (H)) of the sample of stocks.

From the above two sortings (two market capitalization and three book-to-market portfolios), six portfolios were constructed (SL, SM, SH, BL, BM, and BH) from the intersection of two market capitalization portfolios (S and B) with three book-to-market ratio portfolios (L, M and H). For instance, stocks with small market value and low book-to-market ratio go into portfolio SL, and so on. Finally, the value-weighted rate of return is calculated for each one of the six constructed portfolios on a monthly basis, from July of year t to June of year t+1. All the previous processes of sorting, constructing portfolios and calculated

monthly rates of returns will be repeated for the period from July 2001 to April 2010.

The six portfolios are constructed for the purpose of measuring the dependent variables (SMB and HML). For the purpose of measuring the independent variable (rate of return on asset) in time-series regression, 16 portfolios are constructed. First, the sample of stocks sorted according to market value and allocated into four portfolios (MC_1, MC_2, MC_3 and MC_4), by 25 % of sorted sample in each one. For example, stocks within the lowest 25% of market capitalization ranking go into portfolio MC1, and so on. Second, stocks within each one of the previous four portfolios are resorted according to their book-to-market ratio and reallocated, sequentially, into four portfolios in an equal proportion of stock in each portfolio. Finally, this process produced 16 portfolios (MC_{11}, MC_{12}, MC_{13}, MC_{14}, MC_{21}, and so on). For clarification, stocks that make up portfolio MC_1 and also fall within the group of lowest book-to-market ratio within the same market capitalization group go into portfolio MC_{11}. Also, value-weighted rate of return for these 16 portfolios is calculated on a monthly basis through the period from July 2001 to April 2010.

4-4-the Model of the Study

This section shows the time-series regression that is used to test the FF Three-Factor Model validity. It also describes in detail the way in which the input variables for this time-series regression are measured.

4-4-1- Time-Series Regression

To test the ability of the FF Three-Factor Model to predict stock rate of return in ASE, the current study follows **Fama and French** (1993) and uses the time-series regression like the one introduced by **Black *et al.*** (1972. This time-series regression is shown below:

$$R_{pt}-R_{ft}=a_0+\beta_1(R_{mt}-R_{ft})+\beta_2(SMB_t)+\beta_3(HML_t)+e_i$$

Where

R_{pt} : is the rate of return portfolio at month t.

R_{ft} : is the risk free rate of return at month t.

R_{mt}: is the rate of return on the market portfolio at month t.

SMB_t: is the market capitalization mimicking factor at month t.

HML_t: is the book-to-market mimicking factor at month t

e_i: is the error term.

a_0: is the intercept.

β_1, β_2, β_3: sensitivity associated with each corresponding factor.

In addition to the above three factor regression, this study also runs another three regressions. The first one is with a single market factor (R_{mt}-R_{ft}), and the other two regressions include two factors: one of them is market factor and the last either a market capitalization factor (SMB) or a book-to-market factor (HML). There are two purposes for these three additional time-series regressions. The first one is added for the purpose of comparing predictive power of the FF-Three-Factor Model with the well-known Single Factor Model, i.e. the CAPM. The second and third are added to detect the additional explanatory power, each factor (SMB and HML) individually added to the traditional form of the CAPM.

4-4-2- The Dependent Variable and Explanatory Variables

The input variables needed to run the time-series regressions to test the FF Three-Factor Model are as follows:

4-4-2-1- The Dependent Variable (R_{pt}-R_{ft})

This variable is the monthly excess rate of return for the portfolios, which is measured as the rate of return on a portfolio at month t minus risk-free rate (rate of return on one month treasury bills). As mentioned earlier, the value-weighted rate of return on the 16 portfolios constructed in the previous section

is used as R_{pt} variable. In each month from July 2001 to April 2010, the rates of returns on 16 portfolios are subtracted from the rate of return on the treasury bills to get a monthly series of excess rate of return for each one of the 16 portfolios.

4-4-2-2- The Explanatory Factors

They are the following:

(i) Market Factor or Market Risk Premium (R_{mt}-R_{ft}):

This factor is measured in the same way proposed by the CAPM. The monthly changes in the ASE value-weighted index (proxy for R_m), subtracted from it the rate of return of the one month treasury bills (Risk free rate of return). The difference between the market portfolio and the treasury bills rate represents the market risk premium (market risk factor).

(ii) The SMB, the Size Risk Premium:

This factor represents the premium required by investors as compensation for carrying the size risk, which is the difference in the rate of return between a small market capitalization companies and large market capitalization ones. As in Fama and French (1993), the SMB risk factor is measured monthly as the difference between the simple average rate of return on the three small market capitalization portfolios (SL, SM, and SH) and the

simple average rate of return on the three big capitalization portfolios (BL, BM, and BH), algebraically:

$$SMB = ((SL + SM + SH) - (BL + BM + BH))/3$$

(iii) The HML, the Value Risk Premium:

Like the SMB factor, this factor or risk price is required by investors as a compensation for exposure to value risk, which is the difference in the rate of return between the high book-to-market ratio stock (Value stock) and low book-to-market ratio stock (Glamour stock). The HML is measured monthly as the difference between the simple average rate of return on the two high book-to-market portfolios (SH, BH) and the low book-to-market portfolios (SL, BL), algebraically:

$$HML = ((BH + SH) - (BL + SL))/2$$

4-5- Statistical Tools

In this study, Ordinary Least Squares Method (OLS) has been used to estimate the time-series regression parameters (α_0, β_1, β_2 and β_3). Therefore, in judging the statistical significance of these parameters (coefficients), t-test is used. R^2 is used as the good of fitness criterion. Also, the study focuses on the α_0 parameter is to test the predictive power of the model. According to the asset pricing theory α_0 (intercept) should be significantly equal to zero. When this

parameter equals zero, then the model is doing well in explaining variation in the rate of return.

CHAPTER FIVE

EMPIRICAL RESULTS

5-1- Introduction

This chapter reported in detail the statistical description of the portfolios constructed in the previous chapter and the empirical results of tests that run by using ordinary least squares (OLS). It consists of four sections. The first section describes statistically the dependent and independent variables. From section 2 to 4, the empirical results of the OLS are reported.

5-2- Statistical Description of the Portfolios

This section aims to give an overview of the statistical description of portfolios and input variables of the time-series regression, which generated by portfolios aggregation procedures in Chapter Four. Table (5-1) describes the number of stocks in each of the 6 portfolios that constructed for the purpose of generating independent factors in the time-series regression.

Table (5-1)

Number of Stocks in 6 Portfolios Formed in Size and Book-to-Market Ratio

Date	SL	SM	SH	BL	BM	BH	**Total**
2001-02	7	13	18	16	17	5	**76**
2002-03	5	19	23	23	18	5	**93**
2003-04	5	24	19	23	15	10	**96**
2004-05	5	23	25	26	19	7	**105**
2005-06	4	28	34	35	24	6	**131**
2006-07	5	25	32	33	25	5	**125**
2007-08	18	33	36	34	37	17	**175**
2008-09	18	34	32	32	34	18	**168**
2009-10	18	30	33	30	35	15	**161**
Average	**9.4**	**25.4**	**28**	**28**	**24.9**	**9.8**	**125.6**

Source: Calculated by the researcher

SL: Portfolio of stock with small market capitalization and low book-to-market ratio

SM: Portfolio of stock with small market capitalization and medium book-to-market ratio

SH: Portfolio of stock with small market capitalization and high book-to-market ratio

BL: Portfolio of stock with big market capitalization and low book-to-market ratio

BM: Portfolio of stock with big market capitalization and medium book-to-market ratio

BH: Portfolio of stock with big market capitalization and high book-to-market ratio

It can be seen from the table (5-1) that the small stocks are concentrated in the portfolios with a high book-to-market ratio, and big portfolios concentrated in the portfolios with a low book-to-market ratio, which may gives an indication that the small stocks are distressed because it's low earnings generating capability in the future. On the contrary, the big capitalization of stocks gives the sign of high earning capability in the future

Table (5-2 and 5-3) show the statistical description of the excess rates of returns for the two sets of portfolios, Recall that 6 portfolios had been constructed for the purpose of generating independent variables, and 16

portfolios had been constructed for generating dependent variables. Also with each table there is a chart in order to facilitate review of the results reported in the table.

Table (5-2)

The Mean of the Monthly Excess Rate of Return and Standard Deviation of the 6 portfolios

Book-to-Market Ratio						
size	Low(L)	Medium(M)	High(H)	Low(L)	Medium(M)	High (H)
	Means			Standard Deviations (Sharpe Ratio)		
Small (S)	0.62	1.60	2.18	6.15(0.1)	6.75(0.24)	7.21(0.3)
Big(B)	1.13	1.89	1.75	6.99(0.16)	7.36(0.26)	9.35(0.19)

Source: Calculated by the researcher

Note: Intersection of Small (S) with Low (L) indicates to portfolio SL, and so on.

Figure (5-1)

The Mean of the Monthly Excess Rate of Return and Standard Deviation of the 6 portfolios

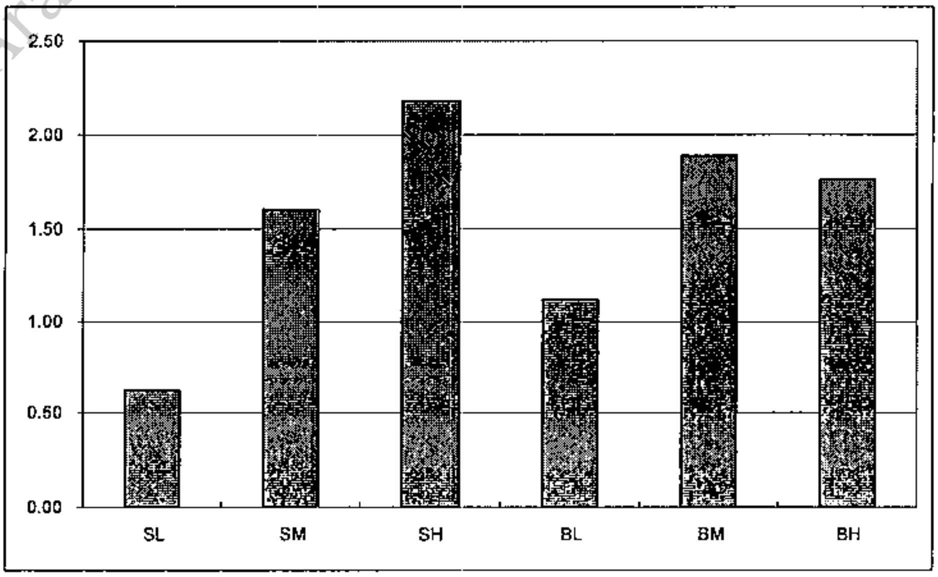


Table (5-2) shows that small size portfolio with high book-to-market ratio (SH) outperformed big size portfolio with high book-to-market value (BH), the other two big portfolios (BL and BM) are winners. On average, the three big portfolios have a higher excess rate of return more than the small portfolios. These evidences are in a contradicted with **Fama and French** (1993), which found that small capitalization portfolios have higher rate of return than big ones. on the other hand, these evidences are in agreement with the ones found in small emerging market, such as **Maris** (2009), which found that big stock outperforms small stock in Athens Stock Exchange. Also, the same thing found by **Limthawaranun** (2007) in Thai Stock Exchange. We infer from this evidence that the big portfolios more risky than small portfolios. This is correct if investors rationally reflect the stock fundamentals in their market price.

Table (5-3)
The Mean of the Monthly Excess Rate of Return and Standard Deviation of the 16 portfolios

	Book-to-Market Ratio							
Size	L 1	2	3	H 4	L1	2	3	H 4
	Means				Standard Deviations (Sharpe Ratio)			
MC1	1.48	2.20	2.45	3.65	7.2(0.2)	8.9(0.25)	7.1(0.34)	12.4(0.29)
2	0.74	1.88	1.10	2.21	6.6(0.11)	8.2(0.23)	9.1(0.12)	9.1(0.24)
3	0.77	1.25	1.42	1.78	6.0(0.13)	6.8(0.18)	8.5(0.17)	8.4(0.21)
MC4	1.44	1.77	1.30	3.00	8.3(0.17)	6.8(0.26)	7.2(0.18)	10.1(0.3)

Source: Calculated by the researcher

Figure (5-2)

The Mean of the Monthly Excess Rate of Return and Standard Deviation of the 16 portfolios

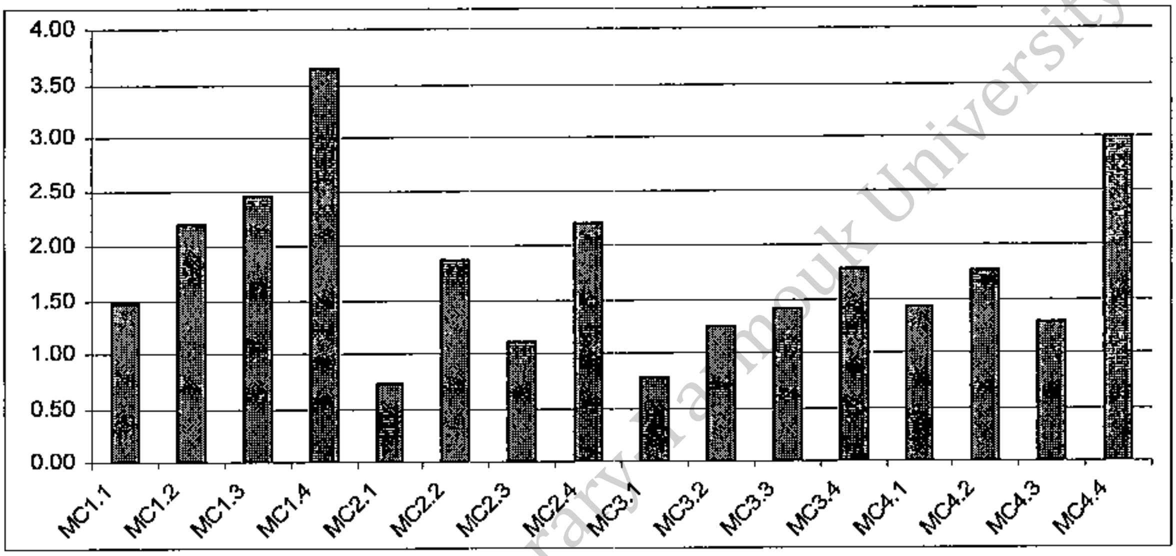


Table (5-3), shows that, in general, the small portfolios tend to have higher return than big portfolios. This is in contradiction with the results in table (5-2), and somehow consistent with **Fama and French** (1993) and other studies. This may occurs because the aggregation procedures and method of calculating the rate of return of the 16 portfolios different from the ones used in the 6 portfolios that reported in the table (5-2). In contrast with previous evidence about superiority of big portfolios over small portfolios, the current study agrees with previous study conducted in the large and developed markets about superiority of high book-to-market portfolios over low book-to-market portfolios. This evidence of superiority for high book-to-market portfolios is stronger than the one found for big portfolios over small ones. Both sets of

portfolios (table 5-2 and table 5-3) with high book-to-market portfolios have higher excess rate of return than low book-to-market portfolios, with except of some cases. Also, the differences in excess rate of return between high and low portfolios are broader than differences between small and big portfolios.

As a measure of risk, standard deviation does not reflect an increase or a decrease in the excess rates of return of stocks in most of cases. That may occur because one of two reasons: (i) investors are irrational in pricing stocks and their behavior in investment does not reflect the risk in market, or (ii) because the standard deviation is a measure of total risk, so it doesn't reflect the actual risk that investors consider when pricing stocks. In summary, we find that standard deviations for small portfolios and high book-to-market portfolios are higher than big and low book-to-market portfolios. This means that these portfolios have higher total risk. In measuring the performance of different portfolios, the current study uses Sharpe measure ((R_p-R_f)/standard deviation). According to the Sharpe ratio, on the average, small and high portfolios have a higher performance than big and low portfolios. Therefore, the investors should invest in small-high or big-high portfolios, since these portfolios yield the highest monthly excess rate of return, equal to 3.65% (43.8%) yearly and 3% (36%) yearly in SH and BH respectively. Also investor can generate superior rate of return if he invests in small portfolio. The difference in the excess rate of

return between 4 smallest portfolios and 4 biggest portfolios is about 6.8% yearly.

Table (5-4) represents statistical description of the independent variables of the time-series regression.

Table (5-4)

Independent Variables: Mean of the Monthly Value of the Market, HML, and SMB Risk Premiums

Risk premium	Mean	St.Dev
R_m-R_f premium	1.16	6.87
HML premium	1.04	5.60
SMB premium	-0.13	4.64

Source: calculated by the researcher

HML: Is the difference in the rates of return between high book-to market portfolios and low book-to-market portfolios, SMB: Is the difference in the rates of return between small size portfolios and big size portfolios

The above table reports the monthly average and standard deviation of the excess rate of return for explanatory variables market; HML and SMB risk premiums in ASE from July 2001 to April 2010. The market risk premium has the highest average monthly excess rate of return and standard deviation followed by HML, and SMB in the last rank. The high standard deviation of the excess rate returns for these three explanatory variables will strengthen their power in explaining the excess rates of returns of portfolios.

Table (5-5) details the independent variables of the time series regression. In this table the mean for each independent variable is shown at each year rather than on the overall period as in the table (5-3).

Table (5-5)

Independent Variables: Mean of the Monthly value of the Market, HML and SMB Risk Premiums

Date	SMB	HML	R_m- R_f
2001-2002	-3.15	2.60	2.04
2002-2003	1.45	1.29	0.48
2003-2004	0.35	1.12	2.70
2004-2005	-2.42	3.52	8.44
2005-2006	1.74	-1.70	-1.85
2006-2007	1.02	1.19	-0.81
2007-2008	-2.99	0.13	4.81
2008-2009	1.58	-0.35	-4.65
2009-2010	-0.76	1.62	-1.12

Source: calculated by the researcher

Interestingly, the average monthly excess rates of return for the small portfolios over big portfolios which measured by SMB, is increased when the market premium is decreased. This result is consistent with the result of correlation between the SMB and the market risk premium (R_m- R_f). In addition, this result may indicate that when the market is poor the small size premium appears strongly, while when the market is strong and in rally, the big portfolios premium appears. Also, shows that the SMB is highly fluctuating from year to year. The HML premium is more consistent than the SMB

premium, and generally higher. The HML premiums are positive in 7 out of 9 years while the SMB premium is positive in 5 out of 9 years.

5-3- Correlation between Independent Variables

The following table (5-6) shows the correlation coefficients between independent variables. It is important for independent variables to be uncorrelated or to have low correlation between each of them. Because that high correlation between independent variables affects their jointly power in explaining the independent variables, which is in this study the excess rate of return on the portfolios constructed according to size and book-to-market ratio. When the independent variables have high correlation, the estimation technique wouldn't be able to estimate the actual coefficients for these variables.

Table (5-6)

The Correlation Coefficient between Independent Variables, the Market, HML, and SMB Risk Premiums

Variable	SMB	HML	R_m-R_f
SMB	1		
HML	-0.2	1	
R_m-R_f	-0.52	0.041	1

According to the table (5-6), SMB premium and market risk premium (R_m-R_f) is highly negatively correlated (ρ=-0.52). So, it is expected that the variation in the SMB variable have an impact on the market beta estimation and

vice versa. Also, it is expected for each one of the market premium and the SMB premium to capture some of each other explanatory power in predicting dependent variable. This finding is in line with Fama and French (1993) which found that the SMB and market premiums are highly correlated but positively rather than negatively as found in the above table (in FF (1993) $\rho = 0.32$). Also, this study found the same result for a correlation between the HML and SMB premiums but less severe ($\rho = -0.2$) and that inconsistent with the Fama and French mentioned study which found more less correlation between the SMB and HML (in FF (1993) $\rho = -0.08$). Finally, the table (5-5) reported thin positive correlation between the HML and market (R_m-R_f) premiums.

5-4- The Time-Series Regression Results

In this section, time-series regression conducted to test the Fama FF Three-Factor ability to predict the excess rate of return for stocks that traded in ASE. For the significance level, the study used $\alpha = 5\%$ for rejection of null hypothesis. The analysis of the FF Three-Factor model will come in three sections: (1) the time-series regression run by using the three factors (R_m-R_f, HML and SMB) as regressors and the excess rate of returns on the 16 portfolios as dependent variables (2) the same three factors will be regressed on the excess rate of return on the 6 portfolios (SL, SM, SH, BL, BM, BH) that formed to

generate the two factors (SMB and HML), and (3) the three factors will be regressed on the average of monthly excess rate of return of 16 portfolios, and once again on average of monthly excess rate of return of 6 portfolios.

5-4-1- Estimating the Excess Return of the 16 Portfolios

Here, R_m-R_f, HML and SMB are regressors and the excess rates of return on the 16 portfolios are dependent variables;

$$R_p - R_f = a_0 + \beta_1 [R_m - R_f] + \beta_2 \text{ SMB} + \beta_3 \text{ HML} + e \qquad (1)$$

Where:

$\grave{a}_0$: is the intercept

$R_p - R_f$: is the monthly excess rate of return of portfolio

$R_m - R_f$: is the monthly market risk premium rate of return.

SMB: is the monthly difference between the rate of return on the small market value portfolio and the rate of return on big market value portfolio.

HML: is the monthly difference between the rate of return on the high book-to-market portfolio and rate of return on the low book-to-market portfolio.

$\beta_1, \beta_2, \beta_3$: are the factor loadings or slopes in the time-series regression

Table (5-7) reports the results of the time-series regression on the three factors, namely the market factor (R_m-R_f), HML and SMB. Also the dependent variable in this regression is the monthly excess rates of return on 16 portfolios.

Table (5-7)

Three Factor Model Test: Three Factors are Regressors and the Excess Rates of Return on the 16 Portfolios are Dependent Variables

	FF Three-Factor Model							
R_p-R_f= $a_0 + \beta_1 (R_m$-$R_f) + \beta_2$ SMB + β_3 HML + e								
	Book-to-Market ratio				Book-to-Market ratio			
	L 1	2	3	H 4	L 1	2	3	H 4
portfolio	a_0				t-statistic			
MC1	0.94	0.94	1.38	1.61	1.44	1.22	2.33	1.66
MC2	-0.26	0.45	-0.75	0.3	-0.57	0.75	-1.38	0.5
MC3	-0.25	0.03	-0.41	0.16	-0.52	0.07	-0.81	0.31
MC4	0.5	0.88	0.08	1.19	0.86	1.92	0.2	1.87
portfolio	β_1				t-statistic			
MC1	0.59	0.69	0.64	1.24	5.5	5.44	6.47	7.71
MC2	0.8	0.9	1.05	0.9	10.6	9.2	11.7	9.1
MC3	0.5	0.72	0.97	0.83	6.3	8.6	11.7	9.7
MC4	0.85	0.69	0.75	0.96	8.6	9.1	10.7	9.12
portfolio	β_2				t-statistic			
MC1	0.38	0.75	0.59	1.15	2.3	3.9	4.0	4.8
MC2	0.94	0.96	1.35	0.82	8.3	6.44	9.9	5.5
MC3	0.3	0.56	0.52	0.04	2.5	4.5	4.1	0.3
MC4	-0.04	-0.16	-0.2	-0.13	-0.3	-1.4	-1.9	-0.81
portfolio	β_3				t-statistic			
MC1	-0.08	0.55	0.4	0.74	-0.69	4.04	3.81	4.29
MC2	0.21	0.5	0.8	0.94	2.56	4.8	8.3	9
MC3	0.47	0.43	0.73	0.63	5.5	4.8	8.25	6.9
MC4	-0.06	0.07	0.3	0.63	-0.53	0.85	4	5.6
portfolio	R^2				s(e)			
MC1	0.24	0.3	0.34	0.42	6.45	7.62	5.89	9.63
MC2	0.55	0.5	0.66	0.6	4.5	5.9	5.4	5.9
MC3	0.41	0.48	0.67	0.64	4.7	5.03	5	5.12
MC4	0.51	0.57	0.68	0.62	5.9	4.5	4.2	6.33

Source: calculated by the researcher

Note: Intersection of MC1 with L1 indicates to portfolio MC1.1, MC1 with 2 indicates to portfolio MC1.2, and so on.

Table (5-7) documents the results of the time series test conducted to examine the ability of the FF Three-Factor Model in predicting the monthly excess rate of return in ASE through period of July 2001 to April 2010. The

market risk premium coefficients, except high book-to-market group, aren't able to explain all variation in the excess rates of returns between small and big portfolios. In an exception to MC4.1, MC4.2, MC4.3, MC4.4 and MC3.4, the SMB coefficients are significant in all portfolios. Also the same thing is true for the HML but more strongly and systematically in reflecting variation in the rates of return. When we move from portfolio with low book-to market portfolio into high book-to market portfolio, the coefficient of the HML becomes higher. Also, the HML coefficients are significant in 14 out of 16 portfolios. This evidence about the existence of superior returns for high book-to-market portfolios over low portfolios is consistent with results found in some international research that conducted on the emerging markets including Jordan, Such as, **Claessens *et al.*** (1995), which found that the rates of return in ASE are significantly related to book-to-market ratio. But the current study contradicts with that study in the result of SMB. That study did not document any significant relationship between the market capitalization and the rates of return. Also the result of HML and SMB, is consistent to somewhat with **Fama and French** (1993) for U.S markets and **Aksu and Onder** (2000) in Turkish market but with less systematic and sever result specifically for the SMB. Comparing with the ability of SMB in reflecting the variation in the excess rate of return between small and big portfolios, the HML has more consistent

relation between increase in its coefficients and the increase in the excess rate of return, and between low book-to-market portfolios and high book-to-market portfolios. The better performance of the HML over the SMB is consistent with the results reported in the table (5-2) and (5-3) regarding a strong and consistent value effect than the size effect in ASE. Despite, that the three factors are jointly significant in capturing the variation in the excess of rates of return between different portfolios. The Three-Factor model can't explain enough variation in the excess of rates of return, specifically, the four smallest portfolios, where the Three-Factor model explains only 0.24% and 0.3% of the variation in of the rates of return of MC1.1 and MC1.2 respectively. Also, that appears in the errors term which is high in all cases.

Table (5-8) reports the result of the time series regression test of the single factor model, i.e. the CAPM. Recall that according to the CAPM the single factor is the market factor (R_m-R_f).

Table (5-8)

The CAPM Test: the Market Risk Premium is the Regressor and the Excess Rates of Return on the 16 Portfolios are the Dependent Variables

	Single Factor Model, the CAPM							
$R_p-R_f= a_0 + \beta\,(R_m-R_f) + e$								
	Book-to-Market ratio				Book-to-Market ratio			
	L 1	2	3	H 4	L 1	2	3	H 4
portfolio	a_0				t-statistic			
MC1	0.95	1.69	1.94	2.65	1.47	2.02	3.22	2.45
MC2	0.19	1.2	0.4	1.47	0.33	1.68	0.49	1.83
MC3	0.3	0.62	0.47	0.81	0.57	1.08	0.74	1.34
MC4	0.45	0.91	0.34	1.8	0.77	2.02	0.75	2.5
portfolio	β				t-statistic			
MC1	0.46	0.45	0.44	0.86	4.85	3.73	4.79	5.49
MC2	0.47	0.58	0.6	0.64	5.76	5.66	5.16	5.53
MC3	0.41	0.54	0.82	0.84	5.35	6.57	8.86	9.56
MC4	0.86	0.74	0.82	1.03	10.34	11.5	12.6	9.96
portfolio	R^2				s(e)			
MC1	0.19	0.12	0.18	0.23	6.6	8.5	6.5	11.0
MC2	0.24	0.24	0.2	0.23	5.77	7.2	8.2	8.1
MC3	0.22	0.29	0.43	0.47	5.37	5.8	6.5	6.2
MC4	0.51	0.56	0.6	0.49	5.86	4.6	4.6	7.3

Source: calculated by the researcher

Table (5-8) shows that market coefficients for small portfolios groups (MC1 and MC2) are lower than those estimated by the three factors. This decrease in the market risk premium coefficient occurs due to the exit of the SMB from the regression. Fama and French (1993) suggested that the market premium coefficients are collapsed toward one in the Three-Factor Model as a result of the high correlation between the SMB and the market risk premium (ρ = - .52). According to the CAPM test, the market risk premium definitely could not be able to explain the higher excess of rates of return of small portfolios

over big portfolios. The market premium estimated coefficients indicate that big portfolios are more risky than small portfolios at the same level of the book-to-market ratio. Thus, the market factor coefficients are not reflecting higher rate of return for the small portfolios that reported in the table (5-3). This evidence about failure of the CAPM in capturing variation in the rates of return between the size-sorted portfolios is consistent with studies of **Fama and French** (1992, 1993), **Davis *et al.*** (2000), **Aksu and Onder** (2000) and Connor and Sehgal (2000). Comparing with the FF Three-Factor Model, the single factor model, the CAPM, is less satisfactory in explaining the variation in the excess of rates of return between portfolios sorted according to the market capitalization and book-to-market ratio. Where most of R^2s for the CAPM are lower than those for the FF Three-Factor Model. Also, in the CAPM used the standard errors of the estimation is higher except in some cases and more intercepts, $\grave{a}_0$, are become significantly different from zero.

Table (5-9) reports the results of testing the CAPM with the SMB alone. The purpose of this test is to examine the additional explanatory power that added by the SMB to the CAPM.

Table (5-9)

The CAPM with SMB: the Market Risk Premium and the SMB are Regressors and the Excess Rates of Return on the 16 Portfolios are the Dependent Variables

	Two-Factor Model							
R_p-R_f = $a_0 + \beta_1 (R_m$-$R_f) + \beta_2$ SMB + e								
	Book-to-Market ratio				Book-to-Market ratio			
	L 1	2	3	H 4	L 1	2	3	H 4
portfolio	a_0				t-statistic			
MC1	0.85	1.54	1.82	2.42	1.34	1.91	2.94	2.35
MC2	-0.03	1	0.12	1.33	-0.07	0.12	0.18	0.09
MC3	0.26	0.51	0.4	0.85	0.49	0.93	0.63	1.4
MC4	0.45	0.95	0.41	1.88	0.77	2.13	0.93	2.64
portfolio	β_1				t-statistic			
MC1	0.6	0.66	0.61	1.19	5.58	4.82	5.84	6.86
MC2	0.78	0.87	1	0.83	10.17	8.02	8.59	6.35
MC3	0.47	0.7	0.92	0.79	5.21	7.52	8.68	7.67
MC4	0.85	0.68	0.73	0.92	8.7	9.06	9.71	7.68
portfolio	β_2				t-statistic			
MC1	0.4	0.59	0.47	0.94	2.55	2.92	3.05	3.66
MC2	0.88	0.81	1.11	0.52	7.72	5.07	6.5	2.83
MC3	0.16	0.44	0.31	-0.14	1.21	3.21	1.94	-0.95
MC4	-0.03	-0.18	-0.28	-0.31	-0.17	-1.62	-2.6	-1.76
portfolio	R^2				s(e)			
MC1	0.23	0.19	0.25	0.31	6.43	8.17	6.26	10.4
MC2	0.52	0.39	0.44	0.28	4.62	6.5	6.95	7.48
MC3	0.23	0.36	0.45	0.47	5.35	5.55	6.4	6.16
MC4	0.51	0.57	0.63	0.5	5.9	4.5	4.48	7.2

Source: calculated by the researcher

We note from the regression results in the table (5-9) that the SMB adds to the explanatory power for the CAPM in explaining variation in the excess rates of return. But, this additional explanatory power for the SMB appeared clearly, only in the two small groups of portfolios (MC1 and MC2). Also, the

coefficient of determination (R^2) is increased; the errors term is decreased as well as the intercept for some portfolios.

The table (5-10) reports the test of the explanatory power added by the HML to enhance the explanatory power of the CAPM in explaining the excess rate of return.

Table (5-10)

The CAPM with HML: the Market Risk Premium and the HML are Regressors and the Excess Rates of Return on the 16 Portfolios are the Dependent Variables

	Two-Factor Model							
$R_p-R_f = a_0 + \beta_1 (R_m-R_f) + \beta_2$ HML + e								
	Book-to-Market ratio				Book-to-Market ratio			
	L 1	2	3	H 4	Low 1	2	3	H 4
portfolio	a_0				t-statistic			
MC1	1.09	1.24	1.62	2.07	1.65	1.51	2.56	1.95
MC2	0.12	0.83	-0.21	0.63	0.21	1.19	-0.28	0.93
MC3	-0.13	0.26	-0.2	0.18	-0.27	0.48	-0.37	0.34
MC4	0.5	0.81	0	1.14	0.84	1.79	0.01	1.8
portfolio	β_1				t-statistic			
MC1	0.46	0.43	0.43	0.84	4.91	3.74	4.83	5.57
MC2	0.47	0.57	0.58	0.61	5.71	5.75	5.44	6.4
MC3	0.39	0.53	0.8	0.82	5.72	6.79	10.43	11.27
MC4	0.86	0.74	0.81	1.01	10.3	11.45	13.48	11.21
portfolio	β_2				t-statistic			
MC1	-0.14	0.44	0.32	0.57	-1.17	3.1	2.86	3.08
MC2	0.07	0.36	0.6	0.82	0.68	2.99	4.58	7.05
MC3	0.42	0.35	0.66	0.62	4.99	3.67	7.03	7.02
MC4	-0.05	0.09	0.33	0.65	-0.48	1.16	4.43	5.88
portfolio	R^2				s(e)			
MC1	0.2	0.19	0.24	0.29	6.59	8.13	6.3	10.6
MC2	0.25	0.3	0.34	0.48	5.78	6.97	7.53	6.69
MC3	0.37	0.38	0.62	0.64	4.84	5.47	5.35	5.09
MC4	0.51	0.57	0.67	0.62	5.88	4.55	4.24	6.3

Source: calculated by the researcher

As shown in the above table, the HML enhance the power of the CAPM in predicting the excess rates of return of portfolios, especially for high book-to-market portfolios with big size. It is noted from the results reported in the table (5-10) that when move from portfolios of low book-to-market ratio to portfolios with higher ratio, the goodness of fit criteria (R^2, α_0, and s (e)) become better.

5-4-2- Estimating the Excess Return of the 6 Portfolios

In this section an additional time series tests will be conducted in a way to support the results that documented in the section (5-3-1).

These additional sets of regressions are the same ones that reported in section (5-3-1), but with one difference. Here the excess rates of returns on the 6 portfolios (SL, SM, SH, BL, BM, BH) that constructed to generate regressors (SMB and HML) are used as a dependent variable in the regression.

Table (5-11) reports the results of the time series test of the Three-Factor Model in estimation the excess rate of return of the 6 portfolios.

Table (5-11)

Three-Factor Model: Three Factors are Regressors and the Excess Rates of Return on the 6 Portfolios are Dependent Variables

	FF Three-Factor Model					
$R_p - R_f = a_0 + \beta_1 (R_m - R_f) + \beta_2$ SMB + β_3 HML + e						
	Book-to-Market ratio			Book-to-Market ratio		
	Low	Medium	High	Low	Medium	High
portfolio	a_0			t-statistic		
S	-0.03	0.24	-0.43	-0.07	0.59	1.45
B	-0.2	0.48	-0.19	0.79	1.2	-0.44
portfolio	β_1			t-statistic		
S	0.76	0.83	0.88	11.18	12.34	18.15
B	0.9	0.85	0.77	21.28	12.78	10.54
portfolio	β_2			t-statistic		
S	0.79	0.91	0.87	7.7	9.04	11.8
B	-0.13	0.06	-0.23	-2.07	0.57	-2.123
portfolio	β_3			t-statistic		
S	-0.1	0.51	0.82	-1.42	7.17	15.8
B	-0.13	0.4	0.96	-2.91	5.64	12.3
portfolio	R^2			s(e)		
S	0.57	0.66	0.84	4.08	4.01	2.91
B	0.87	0.71	0.78	2.54	3.99	4.38

Source: calculated by the researcher

By comparing reported results in the table (5-11) with one reported in table (5-7). It is appearing that the Three-Factor model able to explain the excess rate of return of the 6 portfolios better than that for the 16 portfolios. As documented in the above table, the R^2s are higher than those reported in the table (5-7). Also, the intercepts and the errors term are less in case of the 6 portfolios. In except for portfolio of big size and medium book-to-market ratio, all coefficients of the SMB are statistically significant. The same result is found

for the HML coefficients, but its coefficient is insignificant for the portfolio of small size and low book-to-market ratio.

Table (5-12) reports the results of the CAPM ability in predicting the monthly excess rates of return on the 6 portfolios.

Table (5-12)

The CAPM: the Market Risk Premium is a Regressor and the Excess Rates of Return on the 6 Portfolios are the Dependent Variables

	Single Factor Model, the CAPM					
$R_p - R_f = a_0 + \beta (R_m - R_f) + e$						
	Book-to-Market ratio			Book-to-Market ratio		
	Low	Medium	High	Low	Medium	High
portfolio	a_0			t-statistic		
S	0.06	0.99	1.48	0.12	1.75	2.54
B	0.04	0.91	0.73	0.13	2.03	1.04
portfolio	β			t-statistic		
S	0.48	0.52	0.61	6.5	6.41	7.2
B	0.94	0.85	0.89	25	13.11	8.73
portfolio	R^2			s(e)		
S	0.29	0.28	0.33	5.21	5.74	5.91
B	0.86	0.62	0.42	2.64	4.5	7.13

Source: calculated by the researcher

Table (5-12) shows the same results of failure of the market risk premium in capturing differences in the rate of returns between portfolios. The market risk premium is highly loaded on the big portfolios, specifically, big portfolio with low book-to-market ratio (BL) despite that this portfolio generated lowest rate of return between the big size portfolios. This bias of the market factor in estimating risk of BL portfolio may be result of composition of this portfolio.

Where BL portfolio includes biggest size stocks in ASE and those stocks account for most weight of the value-weighted index. In summary, the market risk premium alone is unable to predict the variation in the rate of return. Therefore, the results reported in this section and section (5-3-1) about the explanatory power of the FF Three-factor Model and the CAPM indicate that the Three-Factor Model is better than the CAPM in estimating the excess rats of return of portfolios in the ASE through the testing period.

Table (5-13) reports the results of two sets of regression. First one consists of the market risk premium and the SMB as a regressors and the other also consist of the market factor but with the HML rather than the SMB.

Table (5-13)

The CAPM with SMB or HML: the Market Risk Premium and either the SMB or HML are Regressors and the Excess Rates of Return on the 6 Portfolios are the Dependent Variables

	Two-Factor Model					
R_p-R_f = a_0 + β_1 (R_m-R_f) + β_2 SMB + e						
	Book-to-Market ratio			Book-to-Market ratio		
	Low	Medium	High	Low	Medium	High
portfolio	a_0			t-statistic		
S	-0.14	0.8	1.33	-0.35	1.66	2.5
B	0.05	0.92	0.86	0.22	2.06	1.27
portfolio	β_1			t-statistic		
S	0.77	0.79	0.8	11.3	9.72	9.2
B	0.91	0.81	0.71	20.8	10.9	6.2
portfolio	β_2			t-statistic		
S	0.82	0.76	0.63	8.1	6.3	4.73
B	0.09	-0.06	-0.51	-1.45	-0.54	-3.03

portfolio	R^2			s(e)		
S	0.57	0.48	0.45	4.1	4.9	5.4
B	0.86	0.62	0.47	2.63	4.6	6.87
	Two-Factor Model					
R_p-R_f = a_0 + β_1 (R_m-R_f) + β_2 HML + e						
	Book-to-Market ratio			Book-to-Market ratio		
	Low	Medium	High	Low	Medium	High
portfolio	a_0			t-statistic		
S	0.29	0.6	0.77	0.56	1.13	1.73
B	0.15	0.51	-0.29	0.58	1.3	-0.65
portfolio	β			t-statistic		
S	0.49	0.51	0.58	6.74	6.7	9.17
B	0.95	0.86	0.85	25.8	14.7	13.44
portfolio	β_2			t-statistic		
S	-0.22	0.38	0.7	-2.46	4.06	8.9
B	-0.11	0.4	1	-2.5	5.66	12.8
portfolio	R^2			s(e)		
S	0.33	0.38	0.62	5.1	5.4	4.5
B	0.87	0.73	0.78	2.6	3.98	4.5

Source: calculated by the researcher

Can be seen from table (5-13) that adding the SMB enhanced ability of the CAPM in predicting monthly excess rates of return for the small portfolios, which is highly loaded on the small portfolios and its coefficients are insignificant on the big portfolios. It seems that the SMB leaves this task for the market risk premium. Also, the results here consistent with one reported by the table (5-10) about additional explanatory power the HML contributes to the CAPM, which this factor did a well job in explaining the excess rates of return for the high book-to-market portfolios over low book-to-market portfolios, its coefficients increase monotonically from low-negative for low book-to-market

portfolios to high positive for high book-to-market portfolios. Also, the result reported in table (5-13) support the results found in this section and the section (5-3) about the stronger power for the HML over the SMB in enhancing the ability of the CAPM in predicting the monthly excess rate of return in ASE

5-4-3- Estimating the Average of Monthly Excess Returns of the Portfolios

Some researchers argued that sorting stocks in the sample according to some empirical regulatory might potentially reduce the errors in variable issue and the lead to exaggerate the relation between those an empirical regulatory, such as size, and influence the results of the pricing model test, (**Lo and Mackinaly**, 1990). In order to deal with this problem the study run a test with three factor and one factor model to examine their ability to predict the monthly average excess rates of return of 6 and 16 portfolios. Table (5-14) shows this test.

Table (5-14)

Time-Series Regression Tree Factors are Regressors and the Monthly Average Excess Rates of Return on the 16 and 6 Portfolios are the Dependent Variables

Panel A						
FF Three-Factor Model						
R_p-R_f = a_0 + β_1 (R_m-R_f) + β_2 SMB + β_3 HML + e						
		Average of 16 Portfolios				
	a_0	β_1	β_2	β_3		
Coefficient	0.004	0.82	0.5	0.45		
t-statistic	2.32	26.9	10.7	13.9	R^2 = 0.90	s(e) =1.8
Panel B						
FF Three-Factor Model						
R_p-R_f = a_0 + β (R_m-R_f) + s SMB + h HML + e						
		Average of 6 Portfolios				
	a_0	β_1	β_2	β_3		
Coefficient	0.002	0.83	0.38	0.41		
t-statistic	1.1	28.1	8.48	12.9	R^2 = 0.91	s(e) = 1.78
Panel C						
Single Factor Model, the CAPM						
R_p-R_f = a_0 + β (R_m-R_f) + e						
		average of 16 portfolios				
	a_0	β				
Coefficient	.010	0.66				
t-statistic	3.3	13.7			R2 = 0.64	s(e) = 3.4
Panel D						
Single Factor Model, the CAPM						
R_p-R_f = a_0 + β (R_m-R_f) + e						
		Average of 6 Portfolios				
	a_0	β				
Coefficient	0.007	0.71				
t-statistic	2.34	16.5			R2 = 0.72	s(e) = 3.04

Source: calculated by the researcher

Table (5-14) documents that the FF Three-Factor Model is very powerful in predicting the variation in average excess rates of returns of both 16 and 6 portfolios. The results is in contrast to the argument that sorting of stock according to the some anomalies reduce the errors in the variables. The explanatory power of three factors in explaining average of monthly variation in the excess of rate of return is stronger than those for the individual portfolios. We see in panel A and B of table (5-14) the Three-Factor able to explain 0.90% of the variation in the both average excess rate of return. Also, the error in estimation doesn't exceed 1.8. **Berk** (2000) showed that break the stocks sample into groups in order to test asset pricing models, lead to a decrease their explanatory power. Then, divergence of results of test of the Three-Factor explanatory power in the table (5-7) and (5-11) about one documented in the table (5-14) is in line with Berks argument, which in the former table the explanatory power of the Three-factor is more powerful than in the table (5-7) and (5-11) specifically for portfolios of small size (MC1.1, Mc1.2, MC1.3 and MC1.4). Again, panel C and D documented low power for the market risk premium in explaining the variation in the excess rate of return. The market factor has a lower coefficient of variation and higher estimation errors and intercept than those for the Three-Factor Model.

CHAPTER SIX

SUMMARY AND CONCLUSIONS

6-1- Summary and Discussion of Empirical Results

This study has aimed not only to test the validity of the Fama and French (1993) Three-Factor Model in predicting monthly excess rate of returns of stocks traded at ASE within the period of July 2001 to April 2010, but also to investigate the size and value effect in ASE. This section highlights and discusses the main results of the study, and compares these results with the ones that found by other studies. The most important results are the following:

First, according to tables (5-2) and (5-3), there is a strong value effect in the ASE within the testing period from July 2001 to April 2010 and the excess rate of returns in most of cases is higher in portfolios with higher book-to-market ratio than in portfolios with lower ratio. There are many interpretations for these results. **Fama and French** (1992, 1993, and 1995) found similar value effects in the U.S markets and argued that the excess rate of returns in the high book-to-market portfolio was a case of a higher risk, so they suggested that high book-to-market ratio was a sign of distress situations expected by the investors. At another level, **Lakonishok *et al.*** (1994) suggested that as a result of mispricing by the investors and the slow price corrections, value stocks are

overpriced while glamour stocks are underpriced. In these results, the study is consistent with some other studies conducted in emerging and small markets, such as **Chui and Wei** (1998) who found similar value effects in each of Thailand, Korea, Malaysia and Hong Kong, and **Gaunt** (2004) who found strong value effects in the Australia market. While **Homsud *et al.*** (2009) found that a reverse value effects in Thailand from 2002 to 2007.

Second, this study does not only find that size effects in the ASE are less consistent and weaker than value effects, but also that the pattern of size-return relations in ASE is different from the one documented by previous studies conducted in the U.S. Table (5-3) reported the smallest size portfolios group. (MC1) always earns a higher rate of returns than other portfolios, and, in the case of second small size group of portfolios (MC2.1, MC2.2, MC2.3 and MC2.4) three out of four portfolios tend to earn higher rate of returns than corresponding ones in the higher size group of portfolios (MC3.1, MC3.2, MC3.3 and MC3.4). But in the case of the biggest size group of portfolios (MC4.1, MC4.2, MC4.3 and MC4.4), the evidence found by this study indicates that these portfolios in the average tend to earn higher rates of return than the two smaller size groups of portfolios (MC2 and MC3). Some researchers argued that the excess rate of return for the small stocks over big stocks is a

compensation for higher risk associated with small size. For example, **Fama and French** (1995) concluded that small size firms tended to be less profitable than big firms, so investors required a higher rate of returns for higher risk that is associated with investment in these firms. On the other side, some researchers suggested that the higher rate of returns for the small stocks is a matter of increase in the cost of investing in these stocks; see **Bhardwaj and Brooks** (1992), and **Stoll and Whaley** (1983). In addition, there are many other interpretations in the literature for the size effect. The evidence which was found about size effect in ASE is consistent with other studies, such as **AL-Khazali** (2001) who found that there is negative relation between market value and the rate of returns in ASE for the period from 1980 to 2000, **Drew *et al.*** (2005) who found similar size effects in the China market, and **AL-Loughani** (2002) who found that small firms in the Kuwaiti market tend to earn higher adjusted rate of returns than large firms.

Third, consistently with **Fama and French** (1993), the study finds that the CAPM is unable to predict the differences in the rate of returns between portfolios sorted according to the market value (size) and book-to-market ratio. Although the big portfolios earn lower rate of returns than small portfolios, it appears from the regression tests results that the market factor coefficients are

always highly loaded on the big portfolios. The same thing is true for book-to-market sorting, but here the market factor does a better job than in size sorting portfolios. The interpretations of these results are one of three: (i) Jordanian investors are irrational and do not reflect the risk inherent in the stocks in their investment decisions; (ii) the CAPM assumptions are violated in ASE's environment, specifically, allowing short selling, this investment activity had been Prohibited in the legislation of the Jordanian capital market; (iii) the CAPM is invalid, there are multiple pervasive factors instead of one single factor as the CAPM assumes. Most recent studies agree with the first and third interpretation. **AL-Khazali** (2001) examined the CAPM's ability to predict the rate of returns in ASE and found that the CAPM did not capture the differential rate of returns for small portfolios over big portfolios, and argued that the inability of the CAPM might be the result of the irrationality of Jordanian investors and of less diversified portfolios held by these investors.

Fourth, the FF Three-Factor Model is better than the CAPM in explaining the variations in the rate of returns in ASE. The results of this study indicate that the additional two factors, namely the SMB and HML, enhance the explanatory power of the CAPM. This evidence is consistent with the **Fama and French** (1993) for U.S markets, **Connor and Sehgal** (2001) for Indian

market, **Drew and Veeraraghavan** (2003) for Hong Kong, Korea, Malaysia and the Philippines. Moreover, **Bitar and Saleh** (2009) found that the size and the book-to-market effects were priced by Jordanian investors and the FF Three-Factor model has an explanatory power over the CAPM in ASE.

Fifth, in comparing with the size related factor (the SMB), the book-to-market related factor (the HML) has stronger and a more meaningful ability to explain the variation in the monthly excess rate of returns. This may be due to the consistent and the strong value effect in ASE. In addition, the HML has a very low correlation with the market risk premium in contrast to the SMB which has a strong negative correlation with market risk premium. So, the HML is able to capture many variations in the rate of returns that are unexplained by the market risk premium as will as the SMB.

Lastly, although the results of the study indicate that the FF Three-Factor Model is better than the CAPM in predicting the monthly excess rate of returns in ASE, the three factor model is still unsatisfactory in some cases. Table (5-7) showed that having an economically significant amount of variations in the excess rate of returns is still unexplained by the FF Three-Factor Model; specifically, the smallest size group portfolios (MC1).

6-2- Recommendations

According to the results found, the study recommends the following:

(i) According to the evidence found about the size and value effects in ASE, the study recommends the traders in ASE to exploit these effects in their investment strategy, by investing in portfolio of smaller market value and portfolio with high book-to-market ratio.

(ii) In the light of results about inferiority of the CAPM and superiority of the FF Three-Factor Model, the study recommended the practitioners in ASE to replace FF Three-Factor Model to the CAPM in the various applications of the asset pricing model

(iii) The study recommends the investors in ASE to take the Size and book-to-market ratio in the consideration when they make their investment decisions.

(iv) The results indicate that the SMB is highly negatively correlated with the market risk premium, so investors in ASE may be able to improve their investment performance by the transferring their investment from big stock to small stock when the market expected to go poorer and from small to big when the market expected to go higher.

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